PROJECT MANUAL – Issue for Bid

Rogue Valley Transportation District Transportation Building Medford, OR

Date:	May 15, 2023
Owner:	Rogue Valley Transportation District 3200 Crater Lake Avenue Medford, OR 97504 p. 541.779.5821
Contact:	Paige West
Architect:	PIVOT Architecture, PC 44 West Broadway, Suite 300 Eugene, Oregon 97401 p. 541.342.7291
Contact:	Kari G. Turner, AIA Burke Wardle, AIA





SECTION 00 0101 PROJECT TITLE PAGE

PROJECT INFORMATION

PROJECT NAME

Rogue Valley Transportation District

Transportation Building

DATE

May 15, 2023

PROJECT OWNER

Rogue Valley Transportation District (RVTD)

PROJECT ADDRESS

3210 Crater Lake Ave (fronted by Forest Hills Drive), Medford, OR 97504

ARCHITECT

PIVOT Architecture, 44 West Broadway, Suite 300, Eugene, OR 97401 Phone: (541) 342-7291

Principal in Charge: Kari G. Turner, AIA - kturner@pivotarchitecture.com Project Contact: Burke Wardle, AIA - bwardle@pivotarchitecture.com

END OF SECTION

SECTION 00 0102

PROJECT INFORMATION

PART 1 GENERAL

1.01 PROJECT IDENTIFICATION

- A. Project Name: Rogue Valley Transportation District (RVTD) Transportation Building, located at 3210 Crater Lake Ave (fronted by Forest Hills Drive) Medford, Oregon 97504.
- B. Architect's Project Number: 2017.01
- C. The Owner, hereinafter referred to as Owner: Rogue Valley Transportation District (RVTD)

1.02 PROJECT DESCRIPTION - SEE SECTION 00 1113

1.03 PROJECT CONSULTANTS

A. PIVOT Architecture

44 West Broadway, Suite 300 Eugene, OR 97401 541.342.7291 Principal in Charge: Kari G. Turner, AIA - kturner@pivotarchitecture.com Project Contact: Burke Wardle, AIA - bwardle@pivotarchitecture.com

B. CIVIL ENGINEER

ZCS Engineering 45 Hawthorne Street Medford, OR 97504 541.884.7421 Contact: Josh Modin - joshm@zcsea.com Contact: Malia Waters - maliaw@zcsea.com

C. STRUCTURAL ENGINEER

ZCS Engineering 45 Hawthorne Street Medford, OR 97504 503.659.2205 Contact: Kristofer Tonning - kristofert@zcsea.com

D. MECAHNICAL AND ELECTRICAL ENGINEER

Systems West Engineers 725 A Street, Springfield, OR 97477 541.342.7210 Contact: Steve Schual - sschual@systemswestengineers.com Contact: Jose Guerrero - jguerrero@systemswestengineers.com

E. LANDSCAPE ARCHITECT

Cameron McCarthy Landscape Architects, LLP 160 East Broadway Eugene, OR 97401 541.485.7385 Principal in Charge: Matt Koehler - mkoehler@cameronmccarthy.com Contact: Zach Rix - zrix@cameronmccarthy.com

1.04 PROCUREMENT TIMETABLE

- A. Construction Documents for Bidding will be available: 05-15-2023
- B. Non-Mandatory Pre-Bid Briefing and Site Tour: 05-23-2023 01:30 PM PDT
- C. Submission of Bids Deadline: 06-20-2023 02:00 PM PDT

- D. Bids will be publicly opened, immediately following the bid closing time. Refer to the Bid Form for location to submit bids and place of bid opening.
- E. First-Tier Subcontractor Disclosure Submission Due: Within two hours of bid closing time.
- F. Anticipated Notice to Proceed: Within 45 days after due date.
- G. Desired Final Completion Date: Not later than 365 calendar days from Mobilization.
- H. The Owner reserves the right to change the schedule, revise or terminate the entire procurement process at any time prior to award.

1.05 PROCUREMENT DOCUMENTS

A. Availability of Documents: Bid Documents may be obtained from Medford Builders Exchange, 2330 Crater Lake Ave. Medford, OR; see Advertisement for Bids for additional information.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

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SEALS PAGE

PROJECT NAME: RVTD TRANSPORTATION BUILDING, MEDFORD, OR 97504 DATE OF ISSUE: MAY 15, 2023

THE FOLLOWING FIRMS DIRECTLY PROVIDED CONTENT FOR THIS PROJECT MANUAL:

ARCHITECTURE AND INTERIOR DESIGN:

PIVOT ARCHITECTURE PC

DIVISIONS 00 THROUGH 12 AND DIVISION 14, AND PORTIONS OF DIVISION 32



STRUCTURAL ENGINEERING

ZCS ENGINEERING

SECTION 03 4100



MECHANICAL ENGINEERING, PLUMBING, AND FIRE SPRINKLERS

SYSTEMS WEST ENGINEERS

DIVISIONS 21, 22 AND 23



ELECTRICAL ENGINEERING AND TECHNOLOGY

SYSTEMS WEST ENGINEERS

DIVISIONS 26, 27 AND 28



CIVIL ENGINEERING

ZCS ENGINEERING

PORTIONS OF DIVISION 31, 32 AND 33



LANDSCAPE ARCHITECTURE

CAMERON MCCARTHY LANDSCAPE ARCHITECTS, LLP

PORTIONS OF DIVISION 32



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SECTION 00 1113 ADVERTISEMENT FOR BIDS

1.01 INVITATION TO BID

- A. Notice is hereby given that sealed bids for Rogue Valley Transportation District- Transportation Building will be received by the RVTD Procurement Department located at 3200 Crater Lake Ave., Medford, OR 97504, until The Bid Closing Time of 2:00 p.m. PDT on Tuesday, June 20, 2023. The Bid Opening time will be immediately after the deadline for submission of bids. Bids will be opened at the above location.
- B. The Project consists of the general construction services for the RVTD Transportation Building and Parking Structure located at 3210 Crater Lake Ave (fronted by Forest Hills Drive) Medford, Oregon 97504 for RVTD, including all site work, mechanical, plumbing, and electrical services. The building consists of approximately 10,000 total square feet of wood frame construction on two floors and a concrete 88 stall, two-story parking garage sited on a 1.34 acre vacant parcel.
- C. Bids are required for the entire work described in the Bidding Documents. Each bid must be submitted on the required form and be accompanied by a bid security in the form of a bid bond, irrevocable letter of credit issued by an insured institution as defined in ORS 706.008, cashier's check, or certified check, payable to Rogue Valley Transportation District in an amount of not less than five percent (5%) of the amount of the bid including additive alternates if any.
- D. Bid Construction Documents may be examined at Medford Builders Exchange, 2330 Crater Lake Ave. Medford, OR, or by visiting <u>https://medfordbuilders.com/search-postings/</u> beginning Monday May 15, 2023.
- E. It is the responsibility of the bidder to check Medford Builders Exchange regularly for addenda that may be issued during the bid period or by signing up to become a member addenda will be sent each week. Addenda will also be posted to RVTD's website at RVTD.org/about/RFP.
- F. Prevailing wage rates in compliance with Davis Bacon Act for public works and construction contracts are required for this project. No bid will be received or considered by RVTD unless the bid contains a statement that the Bidder will comply with the provisions of ORS 279C.800 to 279C.840 and 49 U.S.C. § 5333(a), Davis-Bacon Act regarding the payment of prevailing rates of wage.
- G. All bidders must be "Equal Opportunity Employers" and comply with the appropriate provisions of state and federal law. In regards to Worker's Compensation, all bidders shall be required to comply with ORS 656.017 or are exempt under ORS 656.126.
- H. A Non-Mandatory Pre-Bid Conference will be held **Tuesday May 23, 2023, at 1:30 pm PDT**, at the Project Site to tour the site and answer questions regarding the Project. The tour will begin with a briefing in the Conference Room at 3200 Crater Lake Ave. Medford, OR 97504.
 - In person attendance is encouraged but virtual participation will be provided upon request. Contact Paige West (pwest@rvtd.org) for virtual invitation prior to end of day May 19, 2023.
- I. In accordance with Federal Transit Administration Procurement, each bid must include the following forms at the time of bid submission with an authorized signature. Bidders who do not conform to the requirements set forth in each form may be disqualified.
 - a. Buy America Certification.
 - b. DBE Certification- RVTD's DBE goal for this project is 0.75%.
 - c. Certificate Regarding Lobbying
 - d. Debarment Form
- J. Bidders also agree to conform to the Federal Transit Administration federally required contract clauses in Section 00 7300 Supplementary Conditions.

- K. Bidders also agree to submit example of a similar project in scope and size with a value of at least \$10 million performed by the Bidder.
- L. A fixed price contract will be awarded to the responsible bidder whose bid, conforming to the terms and conditions of the invitation, is the lowest in price.
- M. Each bid must include a statement by the bidder as to whether the bidder is a resident bidder under ORS 279A.120.
- N. A bidder may be deemed unresponsive due to the following:
 - a. The bid package does not contain all of the required elements as described in the advertisement and instructions to bidders.
 - b. The bid fails to conform to material requirements;
 - c. The bid does not conform to applicable specifications except as allowed by using alternates;
 - d. The bid fails to conform to delivery schedule or permissible alternates;
 - e. The bid imposes conditions that would modify the requirements of the invitation or limit the bidder's liability to the entity;
 - f. There is a condition of the bid which affects the substance of the bid (i.e., affects price, quantity, quality, or delivery of the items offered) or works an injustice on other bidders;
 - g. The bid contains prices for line items that are materially unbalanced, i.e., figures in the bid conflict with the total bid price;
 - h. The bid contains inconsistent dates;
 - i. The bidder fails to furnish a bid guarantee in accordance with the requirements of the invitation;
 - j. Failure to submit required forms listed in 1.01 (I.).
 - k. Failure to notarize Bid Form.
 - I. Failure to provide an example of a similar project in scope and size with a value of at least \$10 million performed by the Bidder.
- O. The Owner may reject any bid that does not comply with all prescribed public bidding procedures and requirements, including the requirements to demonstrate the bidder's responsibility under ORS 279C.375(3)(b).
- P. The Owner reserves the right to waive informalities, and for good cause to reject any and all bids after finding that doing so is in the public interest.
- Q. In the event that there is a tie between two bids, RVTD will flip a coin to determine the winner.
- R. No bid will be received or considered unless the bidder is licensed by the Construction Contractors Board or the State Landscape Contractors Board for the work of the project.
- S. Each bidder must submit a disclosure of first-tier subcontractors supplying labor or labor and materials within two hours after the date and time of the deadline when bids are due, in accordance with ORS 279C.370.
- T. Questions regarding bidding procedure shall be directed to the Owner: RVTD's Senior Planner, Paige West, 541-864-9743 or pwest@rvtd.org.
- U. Questions regarding technical matters shall be directed to the project architect, PIVOT Architecture at (541) 342-7291.
- V. ALL ENVELOPES MUST BE SEALED AND PLAINLY MARKED ON THE OUTSIDE SHOWING THE NAME OF THE BIDDER, NAME OF PROJECT "TRANSPORTATION BUILDING", AND THE DATE AND THE HOUR OF OPENING.
- W. By: RVTD
- X. Date: May 12, 2023
- Y. Published in:
 - a. Medford Builders Exchange weekly bulletin
 - b. Medford newspaper or trade publications

END OF SECTION

00 1113 - 2

SECTION 00 2113 INSTRUCTIONS TO BIDDERS

SUMMARY

1.01 SEE MODIFIED AIA DOCUMENT A701 (2018 EDITION), INSTRUCTIONS TO BIDDERS FOLLOWING THIS DOCUMENT. THE CONTRACTOR AND ALL SUB-CONTRACTORS AND SUPPLIERS SHALL READ AND BE GOVERNED BY THEM.

END OF SECTION

AIA Document A701° – 2018

Instructions to Bidders

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

RVTD Transportation Building

THE OWNER: (Name, legal status, address, and other information)

Rogue Valley Transportation District (RVTD)

THE ARCHITECT: (Name, legal status, address, and other information)

PIVOT Architecture

TABLE OF ARTICLES

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

FEDERAL, STATE, AND LOCAL LAWS MAY IMPOSE REQUIREMENTS ON PUBLIC PROCUREMENT CONTRACTS. CONSULT LOCAL AUTHORITIES OR AN ATTORNEY TO VERIFY REQUIREMENTS APPLICABLE TO THIS PROCUREMENT **BEFORE COMPLETING THIS** FORM.

It is intended that AIA Document G612[™]–2017, Owner's Instructions to the Architect, Parts A and B will be completed prior to using this document.

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ARTICLE 1 DEFINITIONS

§ 1.1 Bidding Documents include the Bidding Requirements and the Proposed Contract Documents. The Bidding Requirements consist of the advertisement or invitation to bid, Instructions to Bidders, supplementary instructions to bidders, the bid form, and any other bidding forms. The Proposed Contract Documents consist of the unexecuted form of Agreement between the Owner and Contractor and that Agreement's Exhibits, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, all Addenda, and all other documents enumerated in Article 8 of these Instructions.

§ 1.2 Definitions set forth in the General Conditions of the Contract for Construction, or in other Proposed Contract Documents 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 Alternate Bids.

§ 1.6 An Alternate Bid (or Alternate) is an amount stated in the Bid to be added to or deducted from, or 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.

§ 1.9 A Sub-bidder is a person or entity who submits a bid to a Bidder for materials, equipment, or labor for a portion of the Work.

ARTICLE 2 BIDDER'S REPRESENTATIONS

§ 2.1 By submitting a Bid, the Bidder represents that:

- the Bidder has read and understands the Bidding Documents; .1
- the Bidder understands how the Bidding Documents relate to other portions of the Project, if any, being bid .2 concurrently or presently under construction;
- .3 the Bid complies with the Bidding Documents;
- .4 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;
- .5 the Bid is based upon the materials, equipment, and systems required by the Bidding Documents without exception; and
- .6 the Bidder has read and understands the provisions for liquidated damages, if any, set forth in the form of Agreement between the Owner and Contractor.

ARTICLE 3 **BIDDING DOCUMENTS**

§ 3.1 Distribution

§ 3.1.1 Bidders shall obtain complete Bidding Documents, as indicated below, from the issuing office designated in the advertisement or invitation to bid, for the deposit sum, if any, stated therein.

(Indicate how, such as by email, website, host site/platform, paper copy, or other method Bidders shall obtain Bidding Documents.)

Bid Construction Documents may be examined at Medford Builders Exchange, 2330 Crater Lake Ave. Medford, OR, or by visiting https://medfordbuilders.com/search-postings/. Paper copies will not be provided. One set of plans will be available for on site examination at Medford Builders Exchange.

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§ 3.1.2 Any required deposit shall be refunded to Bidders who submit a bona fide Bid and return the paper Bidding Documents in good condition within ten days after receipt of Bids. The cost to replace missing or damaged paper documents will be deducted from the deposit. A Bidder receiving a Contract award may retain the paper Bidding Documents, and the Bidder's deposit will be refunded.

§ 3.1.3 Bidding Documents will not be issued directly to Sub-bidders unless specifically offered in the advertisement or invitation to bid, or in supplementary instructions to bidders.

§ 3.1.4 Bidders shall use complete Bidding Documents in preparing Bids. Neither the Owner nor Architect assumes responsibility for errors or misinterpretations resulting from the use of incomplete Bidding Documents.

§ 3.1.5 The Bidding Documents will be available for the sole purpose of obtaining Bids on the Work. No license or grant of use is conferred by distribution of the Bidding Documents.

§ 3.2 Modification or Interpretation of Bidding Documents

§ 3.2.1 The Bidder shall carefully study the Bidding Documents, shall examine the site and local conditions, and shall notify the Architect of errors, inconsistencies, or ambiguities discovered and request clarification or interpretation pursuant to Section 3.2.2.

§ 3.2.2 Requests for clarification or interpretation of the Bidding Documents shall be submitted by the Bidder in writing and shall be received by the Architect at least seven days prior to the date for receipt of Bids. (Indicate how, such as by email, website, host site/platform, paper copy, or other method Bidders shall submit requests for clarification and interpretation.)

Requests shall be delivered to the Architect's office by hand, courier, or by email to the attention of the Architect's Contact Person listed in the Project Information section of the Project Manual.

§ 3.2.3 Modifications and interpretations of the Bidding Documents shall be made by Addendum. Modifications and interpretations of the Bidding Documents made in any other manner shall not be binding, and Bidders shall not rely upon them.

§ 3.3 Substitutions

§ 3.3.1 The materials, products, and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance, and quality to be met by any proposed substitution.

§ 3.3.2 Substitution Process

§ 3.3.2.1 Written requests for substitutions shall be received by the Architect at least ten days prior to the date for receipt of Bids. Requests shall be submitted in the same manner as that established for submitting clarifications and interpretations in Section 3.2.2.

§ 3.3.2.2 Bidders shall submit substitution requests on a Substitution Request Form if one is provided in the Bidding Documents.

§ 3.3.2.3 If a Substitution Request Form is not provided, requests shall include (1) the name of the material or equipment specified in the Bidding Documents; (2) the reason for the requested substitution; (3) a complete description of the proposed substitution including the name of the material or equipment proposed as the substitute, performance and test data, and relevant drawings; and (4) any other information necessary for an evaluation. The request shall include a statement setting forth changes in other materials, equipment, or other portions of the Work, including changes in the work of other contracts or the impact on any Project Certifications (such as LEED), that will result from incorporation of the proposed substitution.

§ 3.3.3 The burden of proof of the merit of the proposed substitution is upon the proposer. The Architect's decision of approval or disapproval of a proposed substitution shall be final.

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§ 3.3.4 If the Architect approves a proposed substitution prior to receipt of Bids, such approval shall be set forth in an Addendum. Approvals made in any other manner shall not be binding, and Bidders shall not rely upon them.

§ 3.3.5 No substitutions will be considered after the Contract award unless specifically provided for in the Contract Documents.

§ 3.4 Addenda

§ 3.4.1 Addenda will be transmitted to Bidders known by the issuing office to have received complete Bidding Documents.

(Indicate how, such as by email, website, host site/platform, paper copy, or other method Addenda will be transmitted.)

Addenda will be posted at Medford Builders Exchange, 2330 Crater Lake Ave. Medford, OR, or by visiting https://medfordbuilders.com/search-postings/. It remains the bidders' responsibility to check the Medford Builders Exchange for Addenda prior to submitting a bid.

§ 3.4.2 Addenda will be available where Bidding Documents are on file.

§ 3.4.3 Addenda will be issued no later than four days prior to the date for receipt of Bids, except an Addendum withdrawing the request for Bids or one which includes postponement of the date for receipt of Bids.

§ 3.4.4 Prior to submitting a Bid, each Bidder shall ascertain that the Bidder has received all Addenda issued, and the Bidder shall acknowledge their receipt in the Bid.

ARTICLE 4 BIDDING PROCEDURES

§ 4.1 Preparation of Bids

§ 4.1.1 Bids shall be submitted on the forms included with or identified in the Bidding Documents. The bids shall be notarized and submitted on the Bid Form provided in Section 00 4100 - Bid Form.

§ 4.1.2 All blanks on the bid form shall be legibly executed. Paper bid forms shall be executed in a non-erasable medium.

§ 4.1.3 Sums shall be expressed in both words and numbers, unless noted otherwise on the bid form. In case of discrepancy, the amount entered in words shall govern.

§ 4.1.4 Edits to entries made on paper bid forms must be initialed by the signer of the Bid.

§ 4.1.5 All requested Alternates shall be bid. If no change in the Base Bid is required, enter "No Change" or as required by the bid form.

§ 4.1.6 Where two or more Bids for designated portions of the Work have been requested, the Bidder may, without forfeiture of the bid security, state the Bidder's refusal to accept award of less than the combination of Bids stipulated by the Bidder. The Bidder shall neither make additional stipulations on the bid form nor qualify the Bid in any other manner.

§ 4.1.7 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 Project is located. Each copy of the Bid shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further name the state of incorporation and have the corporate seal affixed. A Bid submitted by an agent shall have a current power of attorney attached, certifying the agent's authority to bind the Bidder.

§ 4.1.8 A Bidder shall incur all costs associated with the preparation of its Bid.

§ 4.2 Bid Security

§ 4.2.1 Each Bid shall be accompanied by the following bid security: (Insert the form and amount of bid security.)

1. Bid Bond of a sum no less than 5 percent of the Bid Amount, using AIA A310 Bid Bond Form. OR

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2. Certified check made payable to Owner in the amount of 5 percent of the Bid Amount.

§ 4.2.2 The Bidder pledges to enter into a Contract with the Owner on the terms stated in the Bid and shall, if required, 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 if required, the amount of the bid security shall be forfeited to the Owner as liquidated damages, not as a penalty. In the event the Owner fails to comply with Section 6.2, the amount of the bid security shall not be forfeited to the Owner.

§ 4.2.3 If a surety bond is required as bid security, it shall be written on AIA Document A310TM, Bid Bond, unless otherwise provided in the Bidding Documents. 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.

§ 4.2.4 The Owner will have the right to retain the bid security of Bidders to whom an award is being considered until (a) the Contract has been executed and bonds, if required, have been furnished; (b) the specified time has elapsed so that Bids may be withdrawn; or (c) all Bids have been rejected. However, if no Contract has been awarded or a Bidder has not been notified of the acceptance of its Bid, a Bidder may, beginning 90 days after the opening of Bids, withdraw its Bid and request the return of its bid security.

§ 4.3 Submission of Bids

§ 4.3.1 A Bidder shall submit its Bid as indicated below: (Indicate how, such as by website, host site/platform, paper copy, or other method Bidders shall submit their Bid.)

As stated on the Bid Form included in the Project Manual.

§ 4.3.2 Paper copies of the Bid, the bid security, and any other documents required to be submitted with the Bid shall be enclosed in a sealed opaque envelope. The envelope shall be addressed to the party receiving the Bids and shall be identified with the Project name, the Bidder's name and address, and, if applicable, the designated portion of the Work for which the Bid is submitted. If the Bid is sent by mail, the sealed envelope shall be enclosed in a separate mailing envelope with the notation "SEALED BID ENCLOSED" on the face thereof.

§ 4.3.3 Bids shall be submitted by the date and time and at the place indicated in the invitation to bid. Bids submitted after the date and time for receipt of Bids, or at an incorrect place, will not be accepted.

§ 4.3.4 The Bidder shall assume full responsibility for timely delivery at the location designated for receipt of Bids.

§ 4.3.5 A Bid submitted by any method other than as provided in this Section 4.3 will not be accepted.

§ 4.4 Modification or Withdrawal of Bid

§ 4.4.1 Prior to the date and time designated for receipt of Bids, a Bidder may submit a new Bid to replace a Bid previously submitted, or withdraw its Bid entirely, by notice to the party designated to receive the Bids. Such notice shall be received and duly recorded by the receiving party on or before the date and time set for receipt of Bids. The receiving party shall verify that replaced or withdrawn Bids are removed from the other submitted Bids and not considered. Notice of submission of a replacement Bid or withdrawal of a Bid shall be worded so as not to reveal the amount of the original Bid.

§ 4.4.2 Withdrawn Bids may be resubmitted up to the date and time designated for the receipt of Bids in the same format as that established in Section 4.3, provided they fully conform with these Instructions to Bidders. Bid security shall be in an amount sufficient for the Bid as resubmitted.

§ 4.4.3 After the date and time designated for receipt of Bids, a Bidder who discovers that it made a clerical error in its Bid shall notify the Architect of such error within two days, or pursuant to a timeframe specified by the law of the jurisdiction where the Project is located, requesting withdrawal of its Bid. Upon providing evidence of such error to the reasonable satisfaction of the Architect, the Bid shall be withdrawn and not resubmitted. If a Bid is withdrawn pursuant to this Section 4.4.3, the bid security will be attended to as follows:

(State the terms and conditions, such as Bid rank, for returning or retaining the bid security.)

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§ 4.4.3: (State the terms and conditions, such as Bid rank, for returning or retaining the bid security.)

ARTICLE 5 CONSIDERATION OF BIDS

§ 5.1 Opening of Bids

If stipulated in an advertisement or invitation to bid, or when otherwise required by law, Bids properly identified and received within the specified time limits will be publicly opened and read aloud. A summary of the Bids may be made available to Bidders.

§ 5.2 Rejection of Bids

Unless otherwise prohibited by law, the Owner shall have the right to reject any or all Bids.

§ 5.3 Acceptance of Bid (Award)

§ 5.3.1 It is the intent of the Owner 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. Unless otherwise prohibited by law, the Owner shall have the right to waive informalities and irregularities in a Bid received and to accept the Bid which, in the Owner's judgment, is in the Owner's best interests.

§ 5.3.2 Unless otherwise prohibited by law, the Owner shall have the right to accept Alternates in any order or combination, unless otherwise specifically provided in the Bidding Documents, and to determine the lowest responsive and responsible Bidder on the basis of the sum of the Base Bid and Alternates accepted.

POST-BID INFORMATION ARTICLE 6

§ 6.1 Contractor's Qualification Statement

Bidders to whom award of a Contract is under consideration shall submit to the Architect, upon request and within the timeframe specified by the Architect, a properly executed AIA Document A305[™], Contractor's Qualification Statement, unless such a Statement has been previously required and submitted for this Bid.

§ 6.2 Owner's Financial Capability

A Bidder to whom award of a Contract is under consideration may request in writing, fourteen days prior to the expiration of the time for withdrawal of Bids, that the Owner furnish to the Bidder reasonable evidence that financial arrangements have been made to fulfill the Owner's obligations under the Contract. The Owner shall then furnish such reasonable evidence to the Bidder no later than seven days prior to the expiration of the time for withdrawal of Bids. Unless such reasonable evidence is furnished within the allotted time, the Bidder will not be required to execute the Agreement between the Owner and Contractor.

§ 6.3 Submittals

§ 6.3.1 After notification of selection for the award of the Contract, the Bidder shall, as soon as practicable or as stipulated in the Bidding Documents, submit in writing to the Owner through the Architect:

- a designation of the Work to be performed with the Bidder's own forces; .1
- .2 names of the principal products and systems proposed for the Work and the manufacturers and suppliers of each; and
- .3 names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for the principal portions of the Work.

§ 6.3.2 The Bidder will be required to establish to the satisfaction of the Architect and Owner the reliability and responsibility of the persons or entities proposed to furnish and perform the Work described in the Bidding Documents.

§ 6.3.3 Prior to the execution of the Contract, the Architect will notify the Bidder if either the Owner or Architect, after due investigation, has reasonable objection to a person or entity proposed by the Bidder. If the Owner or Architect has reasonable objection to a proposed person or entity, the Bidder may, at the Bidder's option, withdraw the Bid or submit an acceptable substitute person or entity. The Bidder may also submit any required adjustment in the Base Bid or Alternate

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Bid to account for the difference in cost occasioned by such substitution. The Owner may accept the adjusted bid price or disqualify the Bidder. In the event of either withdrawal or disqualification, bid security will not be forfeited.

§ 6.3.4 Persons and entities proposed by the Bidder and to whom the Owner and Architect have made no reasonable objection must be used on the Work for which they were proposed and shall not be changed except with the written consent of the Owner and Architect.

ARTICLE 7 PERFORMANCE BOND AND PAYMENT BOND

§ 7.1 Bond Requirements

§ 7.1.1 If stipulated in the Bidding Documents, the Bidder shall furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder.

§ 7.1.2 If the furnishing of such bonds is stipulated in the Bidding Documents, the cost shall be included in the Bid. If the furnishing of such bonds is required after receipt of bids and before execution of the Contract, the cost of such bonds shall be added to the Bid in determining the Contract Sum.

§ 7.1.3 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.

§ 7.1.4 Unless otherwise indicated below, the Penal Sum of the Payment and Performance Bonds shall be the amount of the Contract Sum.

(If Payment or Performance Bonds are to be in an amount other than 100% of the Contract Sum, indicate the dollar amount or percentage of the Contract Sum.)

NA

§ 7.2 Time of Delivery and Form of Bonds

§ 7.2.1 The Bidder shall deliver the required bonds to the Owner not later than three days following the date of execution of the Contract. If the Work is to commence sooner in response to a letter of intent, the Bidder shall, prior to commencement of the Work, submit evidence satisfactory to the Owner that such bonds will be furnished and delivered in accordance with this Section 7.2.1.

§ 7.2.2 Unless otherwise provided, the bonds shall be written on AIA Document A312, Performance Bond and Payment Bond.

§ 7.2.3 The bonds shall be dated on or after the date of the Contract.

§ 7.2.4 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 Copies of the proposed Contract Documents have been made available to the Bidder and consist of the following documents:

AIA Document A101TM–2017, Standard Form of Agreement Between Owner and Contractor, unless .1 otherwise stated below.

(Insert the complete AIA Document number, including year, and Document title.)

- AIA Document A101TM–2017, Exhibit A, Insurance and Bonds, unless otherwise stated below. .2 (Insert the complete AIA Document number, including year, and Document title.)
- .3 AIA Document A201TM–2017, General Conditions of the Contract for Construction, unless otherwise stated below.

(Insert the complete AIA Document number, including year, and Document title.)

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AIA Document E203TM 2013, Building Information Modeling and Digital Data Exhibit, dated as .4 indicated below:.) (Insert the date of the E203-2013.)

.5	Drawings.5 Drawings – Refer to List of Drawings included in the Project Manual.			
	Number	Title	Date	
.6	Specifications - Refer to Table of Cor	ntents included in the Project	Manual	
	Section	Title	Date	Pages
.7	Addenda: - As posted at Medford Builders Exchange.			
	Number	Date	Pages	
.8	Other Exhibits: (Check all boxes that apply and include appropriate information identifying the exhibit where required [] AIA Document E204 TM 2017, Sustainable Projects Exhibit, dated as indicated below:: (Insert the date of the E204-2017.)			
	[] The Sustainability Plan:			
	Title	Date	Pages	
	[] Supplementary and other Conditions of the Contract:			
	Document	Title	Date	Pages
.9	Other documents listed below: (List here any additional documents to	hat are intended to form par	t of the Proposed (Contract Documents.)

<u>NA</u>

SECTION 00 3100

AVAILABLE PROJECT INFORMATION

PART 1 GENERAL

1.01 PERMITS

- A. Owner has applied for the following permits and/or approvals, that are required to be secured prior to commencement of construction work on this project:
 - 1. Planning approvals.
 - 2. Building Permit for all trades.
- 1.02 EXISTING REPORTS AND SURVEYS
 - A. GEOTECHNICAL DESIGN REPORT
 - 1. A copy of a geotechnical report with respect to the building site is included with this document:
 - a. Title: Geotechnical Investigation,
 - b. Date: July 29, 2022
 - c. Prepared by:
 - 1) The Galli Group
 - 2) 612 NW Third Street, Grants Pass, OR 97526
 - 3) Phone: (541) 955-1611
 - 2. This report identifies properties of below grade conditions and offers recommendations for the design of foundations, prepared primarily for the use of Architect.
 - 3. The recommendations described shall not be construed as a requirement of this Contract, unless specifically referenced in the Contract Documents.
 - 4. This report, by its nature, cannot reveal all conditions that exist on the site. Should subsurface conditions be found to vary substantially from this report, changes in the design and construction of foundations will be made, with resulting credits or expenditures to the Contract Price accruing to Owner.
 - 5. The report is included in the Appendix Section of this Project Manual.
 - B. TOPOGRAPHIC SURVEY
 - 1. A copy of a topographic survey with respect to the project site is included for reference within the Project Drawings.
 - 2. This survey identifies grade elevations prepared primarily for the use of Architect in establishing new grades and identifying natural water shed.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 00 4100 BID FORM

THE PROJECT AND THE PARTIES

1.01 DELIVER BIDS TO AND ADDRESS AS FOLLOWS:

- A. Rogue Valley Transportation District (RVTD)
 - ATTN: Paige West

RE: "Transportation Building"

3200 Crater Lake Avenue

Medford, OR 97504

1.02 FOR THE FOLLOWING PROJECT:

- A. RVTD Transportation Building
- 1.03 DATE:

A. Bid Closing Date and Time: Tuesday, June 20, 2023 at 2:00 p.m. (PDT)

B. Bids will be opened publicly, immediately following the bid closing time.

1.04 PLACE OF BID OPENING

A. 3200 Crater Lake Avenue, Medford, OR 97504, Conference Room

1.05 SUBMITTED BY: (BIDDER TO ENTER INFORMATION)

Α.

Bidder's Full Business Name:	
Bidder's Designated Representative:	
Address:	
City, State, Zip:	
Phone:	
E-Mail Address:	

- B. Type of Organization (check one of the following and insert information requested):
 - 1. ____A Corporation organized and existing under the laws of the State of _____
 - 2. ____A Limited Liability Company organized and existing under the laws of the State of
 - 3. A partnership
 - 4. An individual

1.06 BASE BID

	Α.	Having examined the site and being familiar with the conditions affecting the work, Bidder proposes to furnish all material and labor and perform all work hereinafter indicated in strict accordance with the Bidding Documents prepared by PIVOT Architecture for the project identified above, for the following Base Bid amount (written and numerical required):
		dollars
		(\$), in lawful money of the United States
		of America.
	В.	The Base Bid includes all of the work shown on drawings or described in the contract documents.
1.07	INC	CIDENTAL COSTS INCLUDE
	A.	All bid prices include all supervision, transportation, fees, taxes, profit, overhead, insurance, bonds, licenses, permit, and other costs incidental to but required for the Work
1.08	ΤН	E UNDERSIGNED AGREES TO BE BOUND BY THE FOLLOWING DOCUMENTS:
	Α.	Advertisement for Bids
	В.	Instructions to Bidders
	C.	Bid Bond
	D.	First-Tier Subcontractor Disclosure Form
	E.	Agreement
	F.	Performance Bond
	G.	General Conditions
	н.	Supplementary Conditions (Federally Required and Other Model Contract Clauses)
	і. Т	Insurance Requirements
	J. K	
1 09	N.	
1.00	А .	The work consists of the general construction services for the RVTD Transportation Building and Parking Structure including all site work, mechanical, plumbing, and electrical services.
1.10	со	INTRACT TIME OF COMPLETION
	Α.	Bidder agrees that, if this Bid is accepted, Bidder will:
	В.	Complete the Work in 365 calendar days from the beginning of Construction Mobilization on site.
1.11	AD	DENDA
	A.	The undersigned acknowledges that the following Addenda have been received during the bid period. The modifications to the Bid Documents described in the Addenda itemized below have been considered and all costs are included in the Bid Sum.

- 1.
 Addendum # _____ Dated _____.

 2.
 Addendum # _____ Dated _____.

 3.
 Addendum # _____ Dated _____.
- 4. Addendum # Dated

1.12 RESIDENT BIDDER

A. The undersigned certifies that Bidder is / is not (check one) a Resident Bidder as defined in ORS 279A.120.

1.13 CONTRACTOR REGISTRATION

A. The undersigned certifies that Bidder is licensed by the Construction Contractors Board or the State Landscape Contractors Board as follows:

Registration No._____ Expiration Date _____

1.14 BID SECURITY

A. This Bid is accompanied by a bid security in the form of a bid bond, irrevocable letter of credit issued by an insured institution as defined in ORS 706.008, cashier's check, or certified check, payable to RVTD in the amount of five (5%) of the total amount of the Base Bid.

1.15 CONTRACT & BOND

- A. The undersigned agrees, if awarded the contract, to deliver to the Owner within ten (10) days after receiving the contract forms, a fully and properly executed contract, a performance bond and a payment bond complying with ORS 279C.380, and proof of insurance in the forms and amounts required in the Contract Documents.
- B. The surety requested to issue the Performance and Payment Bond will be:
- C. Name and address of Surety Company:
 - 1. Name: _____
 - 2 Address:
 - 3. City/State:
- D. Agent Name/Phone: _____

1.16 NON-COLLUSION

- A. The undersigned certifies that:
 - This bid has been arrived at independently and is being submitted without collusion with 1. any other vendor of materials, supplies, equipment or services to limit independent bidding or competition, and
 - The contents of this bid have not been communicated by the undersigned or its 2. employees or agents to any person not an employee or agent of the undersigned or its surety on any bond furnished with the bid, and will not be communicated to such person prior to the official opening of the bid.

1.17 BID SECURITY FORFEITURE

A. Bidder acknowledges that the bid security accompanying this Bid is submitted to the Owner as a guarantee that, if the Bidder is awarded the contract, the Bidder will execute the contract and furnish the required performance and payment bonds and any required proof of insurance; and that if Bidder fails to promptly and properly execute the contract and deliver the performance bond, payment bond, and proof of insurance within ten (10) days after contract award, Bidder will forfeit the bid security as the measure of liquidated damages which RVTD will sustain, and not as a penalty for failure of the bidder to execute the contract and deliver the bonds and proof of insurance.

1.18 WAGE RATES

A. Bidder agrees, if awarded a contract, that Bidder will comply with the provisions of ORS 279C.838, ORS 279C.840 or Davis-Bacon 40 U.S.C 3141 et seq. as applicable, regarding the payment of the prevailing rates of wage.

1.19 BIDDER ACKNOWLEDGEMENTS

A. By signing this bid, Bidder acknowledges that bidder has read and understands the terms and conditions applicable to the Bid Documents and that bidder accepts and agrees to be bound by the terms and conditions of the contract, including to perform the scope of work and meet the performance standards.

1.20 BIDDER CERTIFICATIONS

- A. By signing below the undersigned certifies that Bidder:
 - 1. Has not discriminated and will not discriminate against a subcontractor in awarding a subcontract because the subcontractor is a minority, women, or emerging small businesses enterprise certified under ORS 200.055 or a business enterprise that is owned or controlled by or that employs a disabled veteran, as defined in ORS 408.225; and
 - 2. To the best of Bidder's knowledge, Bidder is not in violation of any Oregon tax laws described in ORS 305.380(4).

1.21 FIRST-TIER SUBCONTRACTOR DISCLOSURE

- A. Bidder agrees to submit bidder's First-Tier Subcontractor Disclosure within two (2) hours after submission of this bid in the form described below:
 - 1. Section 00 4339 FIRST TIER SUBCONTRACTOR DISCLOSURE FORM (submitted after the bid form as directed in the Instructions to Bidders 00 2113.

1.22 BID FORM SUPPLEMENTS

- A. We agree to submit the following Supplements to Bid Forms within 2 hours after submission of this bid for additional bid information:
 - 1. Section 00 4339 FIRST TIER SUBCONTRACTOR DISCLOSURE FORM (submitted after the bid form as directed in the Instructions to Bidders 00 2113.)
- B. Project example submitted at time of Bid of a similar project in scope and size with a value of at least \$10 million performed by the Bidder.

Project Name:	
Project Address:	
Owner:	
Year of Completion:	
Construction Cost at Completion:	

Brief Project Description:	

1.23 BID EXECUTION

1.24

	Name of Firm:	
	Contractor's Federal I.D. Number (TIN):	
	By: partnership, then one of the partners must sign the bid)	(if bid is by a
	Type or Print Name:	
	If Corporation, Attest: of the Corporation)	(Signed by Secretary
	Type or Print Name:	
NC	TARIZATION OF SIGNATURES	
A.	Subscribed and sworn to before me on the day of (year)	,
B.		
C.		
D.	Notary Public for the State of Oregon. My commission expires:	

1.25 IF THE ABOVE BID IS THAT OF A JOINT VENTURE, ADDITIONAL FORMS OF EXECUTION IDENTIFYING AND BEARING THE SIGNATURE OF EACH MEMBER OF THE JOINT VENTURE IN THE SAME FORM AS ABOVE MUST BE INCLUDED WITH THE BID.

END OF SECTION
SECTION 00 4313 BID SECURITY FORM

PART 1 GENERAL

1.01 FORM OF BID SECURITY

A. Bid guarantee as called for in Instructions to Bidders, Section 00 2113 - Instructions to Bidders may be executed on AIA DOCUMENT A-310 - BID BOND. A copy of this Form is bound in Appendix A of this Project Manual.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

SECTION 00 4339 FIRST TIER SUBCONTRACTOR DISCLOSURE FORM

1.01 DELIVER TO:

- A. Rogue Valley Transportation District
- B. Paige West, 3200 Crater Lake Avenue, Medford, OR 97504
- C. UNLESS STATED OTHERWISE IN THE ORIGINAL SOLICITATION. THIS DOCUMENT SHALL NOT BE FAXED. IT IS THE RESPONSIBILITY OF BIDDERS TO SUBMIT THIS DISCLOSURE FORM AND ANY ADDITIONAL SHEETS. WITH THE BID IDENTIFICATION AND PROJECT NAME CLEARLY MARKED. AT THE LOCATION INDICATED BY THE SPECIFIED DISCLOSURE DEADLINE. SEE INVITATION TO BID AND INSTRUCTIONS TO BIDDERS.

1.02 FOR THE FOLLOWING PROJECT:

A. RVTD Transportation Building

1.03 DATE:

- A. Bid Closing Date and Time: Tuesday, June 20, 2023 at 2:00 p.m. PDT
- B. Bids will be opened publicly, immediately following the bid closing time
- C. First-Tier Submission Due: Within two hours of bid closing time.

1.04 SUBMITTED BY: (BIDDER TO ENTER NAME AND ADDRESS)

- A. Bidder's Full Name _____
 - 1. Address _____
 - 2. City, State, Zip____

 - 3. Phone _____ 4. E-mail:

1.05 SUBMITTAL REQUIREMENTS

- A. Bidders are required to disclose information about certain first-tier subcontractors providing LABOR or LABOR and MATERIALS when the contract value for a Public Improvement is greater than \$100,000 (see ORS 279.027). Specifically, when the contract amount of a first-tier subcontractor is greater than or equal to: (i) 5% of the project bid, but at least \$15,000, or (ii) \$350,000 regardless of the percentage, you must disclose the following information about that subcontract within two (2) hours of bid closing:
 - 1. The subcontractor's name.
 - 2. The dollar value of the subcontract, and
 - 3. The subcontractor's category of work they will be performing.
- B. If you will not be using any subcontractors that are subject to the above disclosure requirements, you are required to indicate "NONE" on the accompanying form.
- C. THE AGENCY MUST REJECT A BID AS NON-RESPONSIVE IF THE BIDDER FAILS TO SUBMIT THE DISCLOSURE FORM WITH THIS INFORMATION.
- D. To determine disclosure requirements, it is recommended that bidders disclose subcontract information for any subcontractor as follows:
 - Determine the lowest possible contract price. That price will be the base bid amount less 1. all alternate deductive bid amounts (exclusive of any options that can only be exercised after contract award).
 - Provide the required disclosure information for any first-tier subcontractor whose potential 2 contract services (i.e., subcontractor's base bid amount plus all alternate additive bid amounts, exclusive of any options that can only be exercised after contract award) are greater than or equal to: (i) 5% of that lowest contract price, but at least \$15,000, or (ii) \$350,000 regardless of the percentage. (iii) Total all possible work for each subcontractor

in making this determination (e.g., if a subcontractor will provide \$15,000 worth of services on the base bid and \$40,000 on an additive alternate, then the potential amount of subcontractor's services is \$55,000. Assuming that \$55,000 exceeds 5% of the lowest contract price, provide the disclosure for both the \$15,000 services and the \$40,000 services).

1.06 LIST OF FIRST-TIER SUBCONTRACTORS MEETING THE ABOVE CRITERIA

- A. This form must be submitted within two (2) working hours of the advertised bid closing date and time.
- B. List below the Name, and category of work of each subcontractor that will be furnishing LABOR or LABOR and MATERIALS that are required to be disclosed. Enter "NONE" if there are no subcontractors that need to be disclosed. (IF NEEDED ATTACH ADDITIONAL SHEETS).

1.07 SUBCONTRACTORS OR SUPPLIERS OF LABOR OR LABOR AND MATERIAL

Α.	Name of subcontractor:
	1. Category of work:
	2. Dollar Value of Subcontract:
В.	Name of subcontractor:
	1. Category of work:
	2. Dollar Value of Subcontract:
C.	Name of subcontractor:
	1. Category of work:
	2. Dollar Value of Subcontract:
D.	Name of subcontractor:
	1. Category of work:
	2. Dollar Value of Subcontract:
E.	Name of subcontractor:
	1. Category of work:
	2. Dollar Value of Subcontract:
F.	Name of subcontractor:
	1. Category of work:
_	2. Dollar value of Subcontract:
G.	Name of subcontractor:
	1. Category of work:
	2. Dollar value of Subcontract:
Н.	Name of subcontractor:
	Category of work: Dellar Value of Subcontract:
Ι.	Name of subcontractor:
	Category of work: Dellar Value of Subcontract:
J.	Name of subcontractor:
	Calegory of work Dollar Value of Subcontract:
K	
n.	Name of subcontractor:
	Name of autoestantestant
L.	Name of subcontractor:
	Oaleyory or work Dollar Value of Subcontract:

1.08 CERTIFICATION OF BIDDERS

- A. The above listed first-tier subcontractor(s) are providing labor and/or labor and materials with a Dollar Value equal to or greater than:
 - 5% of the total Contract Price, but at least \$15,000 (including all alternatives). If the Dollar 1. Value is less than \$15,000 do not list the subcontractor above; or
 - 2. \$350,000 regardless of the percentage of the total Contract Price

1.09 FAILURE TO SUBMIT THIS FORM WILL RESULT IN A BID SUBMITTED BECOMING NON-RESPONSIVE, AND SUCH BIDS SHALL NOT BE CONSIDERED FOR AWARD!

1.10 FORM SIGNATURE(S)

- A. Name of Firm: _____
- B. Address of Firm: _____
- C. City, State, Zip Code: _____
- D. By:
- E. Type or Print Name: _____

SECTION 00 5000

CONTRACTING FORMS AND SUPPLEMENTS

PART 1 GENERAL

1.01 SAMPLE FORMS ARE LOCATED IN THE APPENDIX OF THIS PROJECT MANUAL.

1.02 CONTRACTOR IS RESPONSIBLE FOR OBTAINING A VALID LICENSE TO USE ALL COPYRIGHTED DOCUMENTS SPECIFIED BUT NOT INCLUDED IN THE PROJECT MANUAL.

1.03 AGREEMENT AND CONDITIONS OF THE CONTRACT

- A. See Section 00 5200 Agreement Form for the Agreement form to be executed.
- B. See Section 00 7200 General Conditions for the General Conditions.

1.04 FORMS

- A. Use the following forms for the specified purposes unless otherwise indicated elsewhere in Contract Documents.
- B. Bond Forms:
 - 1. Bid Bond Form: AIA A310.
 - 2. Performance and Payment Bond Form: AIA A312.
- C. Post-Award Certificates and Other Forms:
 - 1. Certificate of Insurance Form: ACORD Certificate of Insurance 25.
 - 2. Schedule of Values Form: AIA G703.
 - 3. Application for Payment Forms: AIA G702 with AIA G703 (for Contractors).
- D. Clarification and Modification Forms:
 - 1. Architect's Supplemental Instructions Form: AIA G710.
 - 2. Construction Change Directive Form: AIA G714.
 - 3. Change Order Form: AIA G701.
- E. Closeout Forms:
 - 1. Certificate of Substantial Completion Form: AIA G704.
 - 2. Contractor's Affidavit of Payment of Debts and Claims: AIA G706
 - 3. Affidavit of Payment of Debts and Claims: AIA G706
 - 4. Contractor's Affidavit of Release of Liens: AIA G706A
 - 5. Consent of Surety to Final Payment: AIA G707
 - 6. Consent of Surety to Reduction in or Partial Release of Retainage: G707A

1.05 REFERENCE STANDARDS

- A. AIA A101 Standard Form of Agreement Between Owner and Contractor where the basis of Payment is a Stipulated Sum; 2017.
- B. AIA A201 General Conditions of the Contract for Construction; 2017.
- C. AIA A310 Bid Bond; 2010.
- D. AIA A312 Performance Bond and Payment Bond; 2010.
- E. AIA G701 Change Order; 2017.
- F. AIA G702 Application and Certificate for Payment; 1992.
- G. AIA G703 Continuation Sheet; 1992.
- H. AIA G704 Certificate of Substantial Completion; 2017.
- I. AIA G706 Contractor's Affidavit of Payment of Debts and Claims: 1994
- J. AIA G706A: Contractor's Affidavit of Release of Liens: 1994
- K. AIA G707: Consent of Surety to Final Payment: 1994
- L. AIA G707A: Consent of Surety to Reduction in or Partial Release of Retainage: 1994
- M. AIA G710 Architect's Supplemental Instructions; 2017.

00 5000 - 1

N. AIA G714 - Construction Change Directive; 2017.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

SECTION 00 5200 AGREEMENT FORM

PART 1 GENERAL

FORM OF AGREEMENT

2.01 THE SAMPLE FORM OF AGREEMENT TO BE EXECUTED FOR THIS CONTRACT (AIA DOCUMENT A101 STANDARD FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR) IS INCLUDED IN THE APPENDIX SECTION OF THIS PROJECT MANUAL.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

SECTION 00 6113 PERFORMANCE & PAYMENT BONDS

PART 1 GENERAL

1.01 FORM OF THE BONDS

A. The Performance & Payment Bonds called for in the General Conditions shall be executed on the AIA DOCUMENT A-312. A copy of this Form is bound in the Appendix Section of this Project Manual.

SECTION 00 6115 PUBLIC WORKS BOND

PART 1 GENERAL

1.01 PUBLIC WORKS BOND

- A. The Contractor and each subcontractor shall have a public works bond in the amount of \$30,000 before starting work, unless exempt under ORS 279C.836(4), (7), (8), or (9). The contractor is required to include in every subcontract a provision requiring the subcontractor to have a public works bond filed with the Construction Contractors Board before starting work on the project, unless an exempt under ORS 279C.836(4),(7),(8) or (9). Before permitting a subcontractor to start work on a public works project, the contractor shall verify that the subcontractor has filed a public works bond or has elected not to file such bond under ORS 279.836 (7) or (8) or is exempt under ORS 279C.836(4) or (9). The Contractor shall provide a certification to RVTD that Contractor and all subcontractors have filed the public works bond, unless exempt under ORS 279C.836(4), (7), (8), or (9).
 - 1. [Effective Jan 1, 2008 Applies to business enterprises certified before, on or after January 1, 2008 and to contracts for projects first advertised, or if not advertised then entered into, on or after January 1, 2008]
- B. This bond is in addition to any performance bond and payment bond requirements. The bond must meet all Bureau of Labor and Industries requirements and provide that the contractor and subcontractor will pay claims ordered by the Bureau of Labor and Industries to workers performing labor on public works projects.

SECTION 00 7200 GENERAL CONDITIONS

FORM OF GENERAL CONDITIONS

1.01 THE GENERAL CONDITIONS APPLICABLE TO THIS CONTRACT (AIA DOCUMENT A201) IS INCLUDED IN THE APPENDIX SECTION OF THIS PROJECT MANUAL.

1.02 CONFLICTS

A. In case of conflict between the "General Conditions" and these specifications, the specifications shall govern.

SUPPLEMENTARY CONDITIONS

2.01 REFER TO DOCUMENT 00 7300 - SUPPLEMENTARY CONDITIONS FOR AMENDMENTS TO THESE GENERAL CONDITIONS.

SECTION 00 7300

SUPPLEMENTARY CONDITIONS

FORM OF SUPPLEMENTARY CONDITIONS

1.01 THE SUPPLEMENTARY CONDITIONS APPLICABLE TO THIS CONTRACT IS ATTACHED FOLLOWING THIS PAGE.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

FEDERALLY REQUIRED AND OTHER MODEL CONTRACT CLAUSES https://www.transit.dot.gov/funding/procurement/best-practices-procurement-manual

REQUIRED FORM ARE INCLUDED AT THE END OF THIS DOCUMENT. FAILURE TO COMPLETE THE FORMS MAY DEEM THE BIDDER NONRESPONSIVE.

ACCESS TO RECORDS AND REPORTS

49 U.S.C. § 5325(g) 2 C.F.R. § 200.333 49 C.F.R. part 633

- a. Record Retention. The Contractor will retain, and will require its subcontractors of all tiers to retain, complete and readily accessible records related in whole or in part to the contract, including, but not limited to, data, documents, reports, statistics, sub-agreements, leases, subcontracts, arrangements, other third party agreements of any type, and supporting materials related to those records.
- b. Retention Period. The Contractor agrees to comply with the record retention requirements in accordance with 2 C.F.R. § 200.333. The Contractor shall maintain all books, records, accounts and reports required under this Contract for a period of at not less than three (3) years after the date of termination or expiration of this Contract, except in the event of litigation or settlement of claims arising from the performance of this Contract, in which case records shall be maintained until the disposition of all such litigation, appeals, claims or exceptions related thereto.
- c. Access to Records. The Contractor agrees to provide sufficient access to FTA and its contractors to inspect and audit records and information related to the performance of this contract as reasonably may be required.
- d. Access to the Sites of Performance. The Contractor agrees to permit FTA and its contractor's access to the sites of performance under this contract as reasonably may be required.

FEDERAL CHANGES

Contractor shall at all times comply with all applicable FTA regulations, policies, procedures and directives, including without limitation those listed directly or by reference in the FTA Master Agreement between the Rogue Valley Transportation District and the FTA, as they may be amended or promulgated from time to time during the term of the Contract. Contractor's failure to so comply shall constitute a material breach of the Contract.

BONDING REQUIREMENTS

2 C.F.R. § 200.325 31 C.F.R. part 223

Bid Guarantee

Bidders shall furnish a bid guaranty in the form of a bid bond, or certified treasurer's or cashier's check issued by a responsible bank or trust company, made payable to Rogue Valley Transportation District (RVTD). The amount of such a guarantee shall be equal to (five percent) 5% of the total bid price. In submitting this bid, it is understood and agreed by bidder that RVTD reserves the right to reject any and all bids, or part of any bid, and it is agreed that the Bid may not be withdrawn for a period of [90] days subsequent to the opening of bids, without the written consent of RVTD. It is also understood and agreed that if the undersigned bidder should withdraw any part or all of his bid within [90] days after the bid opening without the written consent of the RVTD, or refuse or be unable to enter into this Contract as provided above, or refuse or be unable to furnish adequate and acceptable Performance and Payment Bonds, or refuse or be unable to furnish adequate and acceptable insurance, as provided above, it shall forfeit its bid guaranty to the extent RVTD'S damages occasioned by such withdrawal, or refusal, or inability to enter into an agreement, or provide adequate security thereof. It is further understood and agreed that to the extent the defaulting bidder's bid guaranty shall prove inadequate to fully recompense RVTD for the damages occasioned by default, then the undersigned bidder agrees to indemnify RVTD and pay over to RVTD the difference between the bid guarantee and RVTD'S total damages so as to make RVTD whole. The undersigned understands that any material alteration of any of the above or any of the material contained herein, other than that requested, will render the bid unresponsive.

Performance Guarantee

A Performance Guarantee in the amount of **100**% of the Contract value is required by the RVTD to ensure faithful performance of the Contract. Either a Performance Bond or an Irrevocable Stand-By Letter of Credit shall be provided by the Contractor and shall remain in full force for the term of the Agreement. The successful Bidder shall certify that it will provide the requisite Performance Guarantee to the RVTD within ten (10) business days from Contract execution. The RVTD requires all Performance Bonds to be provided by a fully qualified surety company acceptable to the RVTD and listed as a company currently authorized under 31 C.F.R. part 22 as possessing a Certificate of Authority as described hereunder. RVTD may require additional performance bond protection when the contract price is increased. The increase in protection shall generally equal 100 percent of the increase in contract price. The RVTD may secure additional protection by directing the Contractor to increase the amount of the existing bond or to obtain an additional bond. If the Bidder chooses to provide a Letter of Credit as its

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SUPPLEMENTARY CONDITIONS Performance Guarantee, the Bidder shall furnish with its bid, certification that an Irrevocable Stand-By Letter of Credit will be furnished should the Bidder become the successful Contractor. The Bidder shall also provide a statement from the banking institution certifying that an Irrevocable Stand-By Letter of Credit for the action will be provided if the Contract is awarded to the Bidder. The Irrevocable Stand-By Letter of Credit will only be accepted by RVTD if:

1. A bank in good standing issues it. RVTD will not accept a Letter of Credit from an entity other than a bank.

2. It is in writing and signed by the issuing bank.

3. It conspicuously states that it is an irrevocable, non-transferable, "standby" Letter of Credit.

4. The Rogue Valley Transportation District (RVTD) is identified as the Beneficiary.

5. It is in an amount equal to <u>100</u>% of the Contract value. This amount must be in U.S. dollars.

6. The effective date of the Letter of Credit is the same as the effective date of the Contract

7. The expiration date of the Letter of Credit coincides with the term of this Agreement.

8. It indicates that it is being issued in order to support the obligation of the Contractor to perform under the Contract. It must specifically reference the Contract between RVTD and the Contractor the work stipulated herein.

The issuing bank's obligation to pay will arise upon the presentation of the original Letter of Credit and a certificate and draft to the issuing bank's representative at a location and time to be determined by the parties. This documentation will indicate that the Contractor is in default under the Contract.

Payment Bonds

A Labor and Materials Payment Bond equal to the full value of the contract must be furnished by the contractor to RVTD as security for payment by the Contractor and subcontractors for labor, materials, and rental of equipment. The bond may be issued by a fully qualified surety company acceptable to (RVTD) and listed as a company currently authorized under 31 C.F.R. part 223 as possessing a Certificate of Authority as described thereunder.

BUY AMERICA

49 U.S.C. 5323(j) 49 C.F.R. part 661

The contractor agrees to comply with 49 U.S.C. 5323(j) and 49 C.F.R. part 661, which provide that Federal funds may not be obligated unless all steel, iron, and manufactured products used in FTA funded projects are produced in the United States, unless a waiver has been granted by

FTA or the product is subject to a general waiver. General waivers are listed in 49 C.F.R. § 661.7. Separate requirements for rolling stock are set out at 49 U.S.C. 5323(j)(2)(C) and 49 C.F.R. § 661.11.

The bidder must submit to RVTD the appropriate Buy America certification with its bid. Bids that are not accompanied by a completed Buy America certification will be rejected as nonresponsive.

In accordance with 49 C.F.R. § 661.6, for the procurement of steel, iron or manufactured products, use the Buy America certifications below.

THIS REQUIRED FORM IS INCLUDED BELOW. FAILURE TO COMPLETE THIS FORM MAY DEEM THE BIDDER NONRESPONSIVE.

CARGO PREFERENCE – Use of United States-Flag Vessels

46 U.S.C. § 55305 46 C.F.R. part 381

The contractor agrees:

- a. to use privately owned United States-Flag commercial vessels to ship at least 50 percent of the gross tonnage (computed separately for dry bulk carriers, dry cargo liners, and tankers) involved, whenever shipping any equipment, material, or commodities pursuant to the underlying contract to the extent such vessels are available at fair and reasonable rates for United States-Flag commercial vessels;
- b. to furnish within 20 working days following the date of loading for shipments originating within the United States or within 30 working days following the date of loading for shipments originating outside the United States, a legible copy of a rated, "on-board" commercial ocean bill-of-lading in English for each shipment of cargo described in the preceding paragraph to the Division of National Cargo, Office of Market Development, Maritime Administration, Washington, DC 20590 and to the FTA RVTD (through the contractor in the case of a subcontractor's bill-of-lading.); and
- c. to include these requirements in all subcontracts issued pursuant to this contract when the subcontract may involve the transport of equipment, material, or commodities by ocean vessel.

CLEAN AIR ACT AND FEDERAL WATER POLLUTION CONTROL ACT

42 U.S.C. §§ 7401 – 7671q 33 U.S.C. §§ 1251-1387 2 C.F.R. part 200, Appendix II (G)

The Contractor agrees:

1) It will not use any violating facilities;

2) It will report the use of facilities placed on or likely to be placed on the U.S. EPA "List of Violating Facilities;"

3) It will report violations of use of prohibited facilities to FTA; and

4) It will comply with the inspection and other requirements of the Clean Air Act, as amended, (42 U.S.C. §§ 7401 – 7671q); and the Federal Water Pollution Control Act as amended, (33 U.S.C. §§ 1251-1387).

CLEAN WATER

Contractor shall comply with all applicable standards, orders or regulations issued pursuant to the Federal Water Pollution Control Act, as amended, 33 USC 1251 et seq. Contractor shall report each violation to the recipient and understands and agrees that the recipient shall, in turn, report each violation as required to FTA and the appropriate EPA Regional Office. Contractor shall include these requirements in each subcontract exceeding \$150,000 financed in whole or in part with FTA assistance.

PRIVACY ACT

(a) The Contractor agrees to-

(1) Comply with the Privacy Act of 1974 (the Act) and the agency rules and regulations issued under the Act in the design, development, or operation of any system of records on individuals to accomplish an agency function when the contract specifically identifies—

(i) The systems of records; and

(ii) The design, development, or operation work that the contractor is to perform;

(2) Include the Privacy Act notification contained in this contract in every solicitation and resulting subcontract and in every subcontract awarded without a solicitation, when the work statement in the proposed subcontract requires the design, development, or operation of a system of records on individuals that is subject to the Act; and

(3) Include this clause, including this subparagraph (3), in all subcontracts awarded under this contract which requires the design, development, or operation of such a system of records.

(b) In the event of violations of the Act, a civil action may be brought against the agency involved when the violation concerns the design, development, or operation of a system of records on individuals to accomplish an agency function, and criminal penalties may be imposed upon the officers or employees of the agency when the violation concerns the operation of a system of records on individuals to accomplish an agency function. For purposes of the Act, when the contract is for the operation of a system of records on individuals to accomplish an agency function, the Contractor and any employee of the Contractor is considered to be an employee of the agency.

(c)(1) Operation of a system of records, as used in this clause, means performance of any of the activities associated with maintaining the system of records, including the collection, use, and dissemination of records.

(2) Record, as used in this clause, means any item, collection, or grouping of information about an individual that is maintained by an agency, including, but not limited to, education, financial transactions, medical history, and criminal or employment history and that contains the person's name, or the identifying number, symbol, or other identifying particular assigned to the individual, such as a fingerprint or voiceprint or a photograph.

(3) System of records on individuals, as used in this clause means a group of any records under the control of any agency from which information is retrieved by the name of the individual or by some identifying number, symbol, or other identifying particular assigned to the individual.

CIVIL RIGHTS LAWS AND REGULATIONS

The RVTD is an Equal Opportunity Employer. As such, the RVTD agrees to comply with all applicable Federal civil rights laws and implementing regulations. Apart from inconsistent requirements imposed by Federal laws or regulations, the RVTD agrees to comply with the requirements of 49 U.S.C. § 5323(h) (3) by not using any Federal assistance awarded by FTA to support procurements using exclusionary or discriminatory specifications.

Under this Agreement, the Contractor shall at all times comply with the following requirements and shall include these requirements in each subcontract entered into as part thereof.

 Nondiscrimination. In accordance with Federal transit law at 49 U.S.C. § 5332, the Contractor agrees that it will not discriminate against any employee or applicant for employment because of race, color, religion, national origin, sex, disability, or age. In addition, the Contractor agrees to comply with applicable Federal implementing regulations and other implementing requirements FTA may issue.

- 2. Race, Color, Religion, National Origin, Sex. In accordance with Title VII of the Civil Rights Act, as amended, 42 U.S.C. § 2000e et seq., and Federal transit laws at 49 U.S.C. § 5332, the Contractor agrees to comply with all applicable equal employment opportunity requirements of U.S. Department of Labor (U.S. DOL) regulations, "Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor," 41 C.F.R. chapter 60, and Executive Order No. 11246, "Equal Employment Opportunity in Federal Employment," September 24, 1965, 42 U.S.C. § 2000e note, as amended by any later Executive Order that amends or supersedes it, referenced in 42 U.S.C. § 2000e note. The Contractor agrees to take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, national origin, or sex (including sexual orientation and gender identity). Such action shall include, but not be limited to, the following: employment, promotion, demotion or transfer, recruitment or recruitment advertising, layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. In addition, the Contractor agrees to comply with any implementing requirements FTA may issue.
- 3. Age. In accordance with the Age Discrimination in Employment Act, 29 U.S.C. §§ 621-634, U.S. Equal Employment Opportunity Commission (U.S. EEOC) regulations, "Age Discrimination in Employment Act," 29 C.F.R. part 1625, the Age Discrimination Act of 1975, as amended, 42 U.S.C. § 6101 et seq., U.S. Health and Human Services regulations, "Nondiscrimination on the Basis of Age in Programs or Activities Receiving Federal Financial Assistance," 45 C.F.R. part 90, and Federal transit law at 49 U.S.C. § 5332, the Contractor agrees to refrain from discrimination against present and prospective employees for reason of age. In addition, the Contractor agrees to comply with any implementing requirements FTA may issue.
- 4. Disabilities. In accordance with section 504 of the Rehabilitation Act of 1973, as amended, 29 U.S.C. § 794, the Americans with Disabilities Act of 1990, as amended, 42 U.S.C. § 12101 et seq., the Architectural Barriers Act of 1968, as amended, 42 U.S.C. § 4151 et seq., and Federal transit law at 49 U.S.C. § 5332, the Contractor agrees that it will not discriminate against individuals on the basis of disability. In addition, the Contractor agrees to comply with any implementing requirements FTA may issue.

DISADVANTAGED BUSINESS ENTERPRISE (DBE)

49 C.F.R. part 26

For all DOT-assisted contracts, each FTA RVTD must include assurances that third party contractors will comply with the DBE program requirements of 49 C.F.R. part 26, when applicable. The following contract clause is required in all DOT-assisted prime and subcontracts:

The contractor, subrecipient or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 C.F.R. part 26 in the award and administration of DOT-assisted contracts. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the RVTD deems appropriate, which may include, but is not limited to:

- (1) Withholding monthly progress payments;
- (2) Assessing sanctions;
- (3) Liquidated damages; and/or
- (4) Disqualifying the contractor from future bidding as non-responsible. 49 C.F.R. § 26.13(b).

Further, RVTDs must establish a contract clause to require prime contractors to pay subcontractors for satisfactory performance of their contracts no later than 30 days from receipt of each payment the RVTD makes to the prime contractor. 49 C.F.R. § 26.29(a). Finally, for contracts with defined DBE contract goals, each FTA RVTD must include in each prime contract a provision stating that the contractor shall utilize the specific DBEs listed unless the contractor obtains the RVTD's written consent; and that, unless the RVTD's consent is provided, the contractor shall not be entitled to any payment for work or material unless it is performed or supplied by the listed DBE. 49 C.F.R. § 26.53(f) (1).

As an additional resource, RVTDs can draw on the following language for inclusion in their federally funded procurements.

Overview

It is the policy of the RVTD and the United States Department of Transportation ("DOT") that Disadvantaged Business Enterprises ("DBE's"), as defined herein and in the Federal regulations published at 49 C.F.R. part 26, shall have an equal opportunity to participate in DOT-assisted contracts. It is also the policy of the RVTD to:

- 1. Ensure nondiscrimination in the award and administration of DOT-assisted contracts;
- 2. Create a level playing field on which DBE's can compete fairly for DOT-assisted contracts;
- 3. Ensure that the DBE program is narrowly tailored in accordance with applicable law;
- 4. Ensure that only firms that fully meet 49 C.F.R. part 26 eligibility standards are permitted to participate as DBE's;
- 5. Help remove barriers to the participation of DBEs in DOT assisted contracts;
- 6. To promote the use of DBEs in all types of federally assisted contracts and procurement activities; and
- 7. Assist in the development of firms that can compete successfully in the marketplace outside the DBE program.

This Contract is subject to 49 C.F.R. part 26. Therefore, the Contractor must satisfy the requirements for DBE participation as set forth herein. These requirements are in addition to all other equal opportunity employment requirements of this Contract. The RVTD shall make all determinations with regard to whether or not a Bidder/Offeror is in compliance with the requirements stated herein. In assessing compliance, the RVTD may consider during its review of the Bidder/Offeror's submission package, the Bidder/Offeror's documented history of non-compliance with DBE requirements on previous contracts with the RVTD.

Contract Assurance

The Contractor, subrecipient or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this Contract. The Contractor shall carry out applicable requirements of 49 C.F.R. part 26 in the award and administration of DOT-assisted contracts. Failure by the Contractor to carry out these requirements is a material breach of this Contract, which may result in the termination of this Contract or such other remedy as the RVTD deems appropriate.

DBE Participation

For the purpose of this Contract, the RVTD will accept only DBE's who are:

- 1. Certified, at the time of bid opening or proposal evaluation, by the [certifying RVTD or the Unified Certification Program (UCP)]; or
- An out-of-state firm who has been certified by either a local government, state government or Federal government entity authorized to certify DBE status or an RVTD whose DBE certification process has received FTA approval; or
- 3. Certified by another RVTD approved by the RVTD.

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SUPPLEMENTARY CONDITIONS

DBE Participation Goal

The DBE participation goal for this Contract is set at 0.75%. This goal represents those elements of work under this Contract performed by qualified Disadvantaged Business Enterprises for amounts totaling not less than % of the total Contract price. Failure to meet the stated goal at the time of proposal submission may render the Bidder/Offeror non-responsive.

Proposed Submission

Each Bidder/Offeror, as part of its submission, shall supply the following information:

THIS REQUIRED FORM IS INCLUDED BELOW. FAILURE TO COMPLETE THIS FORM MAY DEEM THE BIDDER NONRESPONSIVE.

- A completed DBE Utilization Form provided below that indicates the percentage and dollar value of the total bid/contract amount to be supplied by Disadvantaged Business Enterprises under this Contract.
- 2. A list of those qualified DBE's with whom the Bidder/Offeror intends to contract for the performance of portions of the work under the Contract, the agreed price to be paid to each DBE for work, the Contract items or parts to be performed by each DBE, a proposed timetable for the performance or delivery of the Contract item, and other information as required by the DBE Participation Schedule. No work shall be included in the Schedule that the Bidder/Offeror has reason to believe the listed DBE will subcontract, at any tier, to other than another DBE. If awarded the Contract, the Bidder/Offeror may not deviate from the DBE Participation Schedule submitted in response to the bid. Any subsequent changes and/or substitutions of DBE firms will require review and written approval by the RVTD.
- 3. An original DBE Letter of Intent from each DBE listed in the DBE Participation Schedule.
- 4. An original DBE Affidavit from each DBE stating that there has not been any change in its status since the date of its last certification.

Good Faith Efforts

If the Bidder/Offeror is unable to meet the goal set forth above (DBE Participation Goal), the RVTD will consider the Bidder/Offeror's documented good faith efforts to meet the goal in determining responsiveness. The types of actions that the RVTD will consider as part of the Bidder/Offeror's good faith efforts include, but are not limited to, the following:

- Documented communication with the RVTD's DBE Coordinator (questions of IFB or RFP requirements, subcontracting opportunities, appropriate certification, will be addressed in a timely fashion);
- 2. Pre-bid meeting attendance. At the pre-bid meeting, the RVTD generally informs potential Bidder/Offeror's of DBE subcontracting opportunities;
- 3. The Bidder/Offeror's own solicitations to obtain DBE involvement in general circulation media, trade association publication, minority-focus media and other reasonable and available means within sufficient time to allow DBEs to respond to the solicitation;
- 4. Written notification to DBE's encouraging participation in the proposed Contract; and
- 5. Efforts made to identify specific portions of the work that might be performed by DBE's.

The Bidder/Offeror shall provide the following details, at a minimum, of the specific efforts it made to negotiate in good faith with DBEs for elements of the Contract:

- 1. The names, addresses, and telephone numbers of DBE's that were contacted;
- 2. A description of the information provided to targeted DBE's regarding the specifications and bid proposals for portions of the work;
- 3. Efforts made to assist DBEs contacted in obtaining bonding or insurance required by the Bidder or the Authority.

Further, the documentation of good faith efforts must include copies of each DBE and non-DBE subcontractor quote submitted when a non-DBE subcontractor was selected over a DBE for work on the contract. 49 C.F.R. § 26.53(b) (2) (VI). In determining whether a Bidder has made good faith efforts, the Authority may take into account the performance of other Bidders in meeting the Contract goals. For example, if the apparent successful Bidder failed to meet the goal, but meets or exceeds the average DBE participation obtained by other Bidders, the Authority may view this as evidence of the Bidder having made good faith efforts.

Administrative Reconsideration

Within five (5) business days of being informed by the RVTD that it is not responsive or responsible because it has not documented sufficient good faith efforts, the Bidder/Offeror may request administrative reconsideration. The Bidder should make this request in writing to the RVTD's [Contact Name]. The [Contact Name] will forward the Bidder/Offeror's request to a reconsideration official who will not have played any role in the original determination that the Bidder/Offeror did not document sufficient good faith efforts.

As part of this reconsideration, the Bidder/Offeror will have the opportunity to provide written documentation or argument concerning the issue of whether it met the goal or made adequate good faith efforts to do so. The Bidder/Offeror will have the opportunity to meet in person with the assigned reconsideration official to discuss the issue of whether it met the goal or made adequate good faith efforts to do so. The RVTD will send the Bidder/Offeror a written decision on its reconsideration, explaining the basis for finding that the Bidder/Offeror did or did not meet the goal or make adequate good faith efforts to do so. The result of the reconsideration process is not administratively appealable to the Department of Transportation.

Termination of DBE Subcontractor

The Contractor shall not terminate the DBE subcontractor(s) listed in the DBE Participation Schedule (see below) without the RVTD's prior written consent. The RVTD may provide such written consent only if the Contractor has good cause to terminate the DBE firm. Before transmitting a request to terminate, the Contractor shall give notice in writing to the DBE subcontractor of its intent to terminate and the reason for the request. The Contractor shall give the DBE five days to respond to the notice and advise of the reasons why it objects to the proposed termination. When a DBE subcontractor is terminated or fails to complete its work on the Contract for any reason, the Contractor shall make good faith efforts to find another DBE subcontractor to substitute for the original DBE and immediately notify the RVTD in writing of its efforts to replace the original DBE. These good faith efforts shall be directed at finding another DBE to perform at least the same amount of work under the Contract as the DBE that was terminated, to the extent needed to meet the Contract goal established for this procurement. Failure to comply with these requirements will be in accordance with Section 8 below (Sanctions for Violations).

Continued Compliance

The RVTD shall monitor the Contractor's DBE compliance during the life of the Contract. In the event this procurement exceeds ninety (90) days, it will be the responsibility of the Contractor to submit quarterly written reports to the RVTD that summarize the total DBE value for this Contract. These reports shall provide the following details:

- DBE utilization established for the Contract;
- Total value of expenditures with DBE firms for the quarter;
- The value of expenditures with each DBE firm for the quarter by race and gender;
- Total value of expenditures with DBE firms from inception of the Contract; and
- The value of expenditures with each DBE firm from the inception of the Contract by race and gender.

Reports and other correspondence must be submitted to the DBE Coordinator with copies provided to the [RVTD Name1] and [RVTD Name2]. Reports shall continue to be submitted quarterly until final payment is issued or until DBE participation is completed.

The successful Bidder/Offeror shall permit:

- The RVTD to have access to necessary records to examine information as the RVTD deems appropriate for the purpose of investigating and determining compliance with this provision, including, but not limited to, records of expenditures, invoices, and contract between the successful Bidder/Offeror and other DBE parties entered into during the life of the Contract.
- The authorized representative(s) of the RVTD, the U.S. Department of Transportation, the Comptroller General of the United States, to inspect and audit all data and record of the Contractor relating to its performance under the Disadvantaged Business Enterprise Participation provision of this Contract.
- All data/record(s) pertaining to DBE shall be maintained as stated in Section [insert reference to record keeping requirements for the Project.]

Sanctions for Violations

If at any time the RVTD has reason to believe that the Contractor is in violation of its obligations under this Agreement or has otherwise failed to comply with terms of this Section, the RVTD may, in addition to pursuing any other available legal remedy, commence proceedings, which may include but are not limited to, the following:

- Suspension of any payment or part due the Contractor until such time as the issues concerning the Contractor's compliance are resolved; and
- Termination or cancellation of the Contract, in whole or in part, unless the successful Contractor is able to demonstrate within a reasonable time that it is in compliance with the DBE terms stated herein.

EMPLOYEE PROTECTIONS

49 U.S.C. § 5333(a) 40 U.S.C. §§ 3141 – 3148 29 C.F.R. part 5 18 U.S.C. § 874 29 C.F.R. part 3 40 U.S.C. §§3701-3708 29 C.F.R. part 1926

Prevailing Wage and Anti-Kickback

For all prime construction, alteration or repair contracts in excess of \$2,000 awarded by FTA, the Contractor shall comply with the Davis-Bacon Act and the Copeland "Anti-Kickback" Act. Under 49 U.S.C. § 5333(a), prevailing wage protections apply to laborers and mechanics employed on FTA assisted construction, alteration, or repair projects. The Contractor will comply with the Davis-Bacon Act, 40 U.S.C. §§ 3141-3144, and 3146-3148 as supplemented by DOL regulations at 29 C.F.R. part 5, "Labor Standards Provisions Applicable to Contracts Governing Federally Financed and Assisted Construction." In accordance with the statute, the Contractor shall pay wages to laborers and mechanics at a rate not less than the prevailing wages specified in a wage determination made by the Secretary of Labor. In addition, the Contractor agrees to pay wages not less than once a week. The Contractor shall also comply with the Copeland "Anti-Kickback" Act (40 U.S.C. § 3145), as supplemented by DOL regulations at 29 C.F.R. part 3, "Contractors and Subcontractors on Public Building or Public Work Financed in Whole or in part by Loans or Grants from the United States." The Contractor is prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public work, to give up any part of the compensation to which he or she is otherwise entitled.

Contract Work Hours and Safety Standards

For all contracts in excess of \$100,000 that involve the employment of mechanics or laborers, the Contractor shall comply with the Contract Work Hours and Safety Standards Act (40 U.S.C. §§ 3701- 3708), as supplemented by the DOL regulations at 29 C.F.R. part 5. Under 40 U.S.C. § 3702 of the Act, the Contractor shall compute the wages of every mechanic and laborer, including watchmen and guards, on the basis of a standard work week of 40 hours. Work in excess of the standard work week is permissible provided that the worker is compensated at a rate of not less than one and a half times the basic rate of pay for all hours worked in excess of 40 hours in the work week. The requirements of 40 U.S.C. § 3704 are applicable to construction work and provide that no laborer or mechanic be required to work in surroundings or under working conditions which are unsanitary, hazardous or dangerous. These requirements do not apply to the purchase of supplies or materials or articles ordinarily available on the open market, or to contracts for transportation or transmission of intelligence.

In the event of any violation of the clause set forth herein, the Contractor and any subcontractor responsible therefore shall be liable for the unpaid wages. In addition, the Contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory),

for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of this clause in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by this clause.

The FTA shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the Contractor or subcontractor under any such contract or any other Federal contract with the same prime Contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime Contractor, such sums as may be determined to be necessary to satisfy any liabilities of such Contractor or subcontractor for unpaid wages and liquidated damages as provided in this section.

The Contractor or subcontractor shall insert in any subcontracts the clauses set forth in this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime Contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in this agreement.

Contract Work Hours and Safety Standards for Awards Not Involving Construction

The Contractor shall comply with all federal laws, regulations, and requirements providing wage and hour protections for non-construction employees, in accordance with 40 U.S.C. § 3702, Contract Work Hours and Safety Standards Act, and other relevant parts of that Act, 40 U.S.C. § 3701 et seq., and U.S. DOL regulations, "Labor Standards Provisions Applicable to Contracts Covering Federally Financed and Assisted Construction (also Labor Standards Provisions Applicable to Non-construction Contracts Subject to the Contract Work Hours and Safety Standards Act)," 29 C.F.R. part 5.

The Contractor shall maintain payrolls and basic payroll records during the course of the work and shall preserve them for a period of three (3) years from the completion of the contract for all laborers and mechanics, including guards and watchmen, working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid.

Such records maintained under this paragraph shall be made available by the Contractor for inspection, copying, or transcription by authorized representatives of the FTA and the Department of Labor, and the Contractor will permit such representatives to interview employees during working hours on the job.

The contractor shall require the inclusion of the language of this clause within subcontracts of all tiers.

VETERANS EMPLOYMENT

These requirements apply only to capital projects (see 49 USC Section 5302, Subsection 3). Contractor shall give a hiring preference, to the extent practicable, to veterans (as defined in U.S.C. Section 2108 of title 5) who have the requisite skills and abilities to perform the construction work required under the Contract. This requirement shall not be understood, construed or enforced in any manner that would require an employer to give a preference to any veteran over any equally qualified applicant who is a member of any racial or ethnic minority, female, an individual with a disability, or a former employee.

ENERGY CONSERVATION

42 U.S.C. 6321 et seq. 49 C.F.R. part 622, subpart C

The contractor agrees to comply with mandatory standards and policies relating to energy efficiency, which are contained in the state energy conservation plan issued in compliance with the Energy Policy and Conservation Act.

GOVERNMENT-WIDE DEBARMENT AND SUSPENSION

2 C.F.R. part 180 2 C.F.R part 1200 2 C.F.R. § 200.213 2 C.F.R. part 200 Appendix II (I) Executive

The Contractor shall comply and facilitate compliance with U.S. DOT regulations, "Nonprocurement Suspension and Debarment," 2 C.F.R. part 1200, which adopts and supplements the U.S. Office of Management and Budget (U.S. OMB) "Guidelines to Agencies on Governmentwide Debarment and Suspension (Nonprocurement)," 2 C.F.R. part 180. These provisions apply to each contract at any tier of \$25,000 or more, and to each contract at any tier for a federally required audit (irrespective of the contract amount), and to each contract at any tier that must be approved by an FTA official irrespective of the contract amount. As such, the Contractor shall verify that its principals, affiliates, and subcontractors are eligible to participate in this federally funded contract and are not presently declared by any Federal department or RVTD to be:

- a) Debarred from participation in any federally assisted Award;
- b) Suspended from participation in any federally assisted Award;
- c) Proposed for debarment from participation in any federally assisted Award;
- d) Declared ineligible to participate in any federally assisted Award;
- e) Voluntarily excluded from participation in any federally assisted Award; or
- f) Disqualified from participation in any federally assisted Award.

By signing and submitting its bid or proposal, the bidder or proposer certifies as follows:

The certification in this clause is a material representation of fact relied upon by the RVTD. If it is later determined by the RVTD that the bidder or proposer knowingly rendered an erroneous certification, in addition to remedies available to the RVTD, the Federal Government may pursue available remedies, including but not limited to suspension and/or debarment. The bidder or proposer agrees to comply with the requirements of 2 C.F.R. part 180, subpart C, as supplemented by 2 C.F.R. part 1200, while this offer is valid and throughout the period of any contract that may arise from this offer. The bidder or proposer further agrees to include a provision requiring such compliance in its lower tier covered transactions.

THIS REQUIRED FORM IS INCLUDED BELOW. FAILURE TO COMPLETE THIS FORM MAY DEEM THE BIDDER NONRESPONSIVE.

LOBBYING RESTRICTIONS

31 U.S.C. § 1352 2 C.F.R. § 200.450 2 C.F.R. part 200 appendix II (J) 49 C.F.R. part 20

The undersigned certifies to the best of his or her knowledge and belief, that:

- 1. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an RVTD, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
- 2. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any RVTD, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.
- 3. The undersigned shall require that the language of this certification be included in the award documents for all sub-awards at all tiers (including subcontracts, sub-grants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for

making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

THIS REQUIRED FORM IS INCLUDED BELOW. FAILURE TO COMPLETE THIS FORM MAY DEEM THE BIDDER NONRESPONSIVE.

NO GOVERNMENT OBLIGATION TO THIRD PARTIES

The RVTD and Contractor acknowledge and agree that, notwithstanding any concurrence by the Federal Government in or approval of the solicitation or award of the underlying Contract, absent the express written consent by the Federal Government, the Federal Government is not a party to this Contract and shall not be subject to any obligations or liabilities to the RVTD, Contractor or any other party (whether or not a party to that contract) pertaining to any matter resulting from the underlying Contract. The Contractor agrees to include the above clause in each subcontract financed in whole or in part with Federal assistance provided by the FTA. It is further agreed that the clause shall not be modified, except to identify the subcontractor who will be subject to its provisions.

PROGRAM FRAUD AND FALSE OR FRAUDULENT STATEMENTS AND RELATED ACTS

49 U.S.C. § 5323(I) (1) 31 U.S.C. §§ 3801-3812 18 U.S.C. § 1001 49 C.F.R. part 31

The Contractor acknowledges that the provisions of the Program Fraud Civil Remedies Act of 1986, as amended, 31 U.S.C. § 3801 et seq. and U.S. DOT regulations, "Program Fraud Civil Remedies," 49 C.F.R. part 31, apply to its actions pertaining to this Project. Upon execution of the underlying contract, the Contractor certifies or affirms the truthfulness and accuracy of any statement it has made, it makes, it may make, or causes to be made, pertaining to the underlying contract or the FTA assisted project for which this contract work is being performed. In addition to other penalties that may be applicable, the Contractor further acknowledges that if it makes, or causes to be made, a false, fictitious, or fraudulent claim, statement, submission, or certification, the Federal Government reserves the right to impose the penalties of the Program Fraud Civil Remedies Act of 1986 on the Contractor to the extent the Federal Government deems appropriate.

The Contractor also acknowledges that if it makes, or causes to be made, a false, fictitious, or fraudulent claim, statement, submission, or certification to the Federal Government under a contract connected with a project that is financed in whole or in part with Federal assistance originally awarded by FTA under the authority of 49 U.S.C. chapter 53, the Government reserves the right to impose the penalties of 18 U.S.C. § 1001 and 49 U.S.C. § 5323(I) on the Contractor, to the extent the Federal Government deems appropriate.

The Contractor agrees to include the above two clauses in each subcontract financed in whole or in part with Federal assistance provided by FTA. It is further agreed that the clauses shall not be modified, except to identify the subcontractor who will be subject to the provisions.

RECYCLED PRODUCTS

42 U.S.C. § 6962 40 C.F.R. part 247 2 C.F.R. part § 200.322

Recovered Materials

The Contractor agrees to provide a preference for those products and services that conserve natural resources, protect the environment, and are energy efficient by complying with and facilitating compliance with Section 6002 of the Resource Conservation and Recovery Act, as amended, 42 U.S.C. § 6962, and U.S. Environmental Protection RVTD (U.S. EPA), "Comprehensive Procurement Guideline for Products Containing Recovered Materials," 40 C.F.R. part 247.

SAFE OPERATION OF MOTOR VEHICLES

23 U.S.C. part 402 Executive Order No. 13043 Executive Order No. 13513 U.S. DOT Order No. 3902.10

The Contractor is encouraged to adopt and promote on-the-job seat belt use policies and programs for its employees and other personnel that operate company-owned vehicles, company rented vehicles, or personally operated vehicles. The terms "company-owned" and "company-leased" refer to vehicles owned or leased either by the Contractor or RVTD.

Distracted Driving

The Contractor agrees to adopt and enforce workplace safety policies to decrease crashes caused by distracted drivers, including policies to ban text messaging while using an electronic device supplied by an employer, and driving a vehicle the driver owns or rents, a vehicle Contactor owns, leases, or rents, or a privately-owned vehicle when on official business in connection with the work performed under this agreement.

SEISMIC SAFETY

42 U.S.C. 7701 et seq. 49 C.F.R. part 41 Executive Order (E.O.) 12699

The contractor agrees that any new building or addition to an existing building will be designed and constructed in accordance with the standards for Seismic Safety required in Department of Transportation (DOT) Seismic Safety Regulations 49 C.F.R. part 41 and will certify to compliance to the extent required by the regulation. The contractor also agrees to ensure that all work

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SUPPLEMENTARY CONDITIONS performed under this contract, including work performed by a subcontractor, is in compliance with the standards required by the Seismic Safety regulations and the certification of compliance issued on the project.

SUBSTANCE ABUSE REQUIREMENTS

49 U.S.C. § 5331 49 C.F.R. part 655 49 C.F.R. part 40

FTA's drug and alcohol rules, 49 C.F.R. part 655, are unique among the regulations issued by FTA. RVTD relies on the contractor to implement a drug and alcohol testing program that complies with 49 C.F.R. part 655 but retains the ability to monitor the contractor's testing program; thus, RVTD places the responsibility for complying with the rules on the contractor and to determine who is actually performing a safety-sensitive function. RVTD reserves the right to ensure that the contractor complies with the program.

TERMINATION

2 C.F.R. § 200.339 2 C.F.R. part 200, Appendix II (B)

Termination for Convenience (General Provision)

The RVTD may terminate this contract, in whole or in part, at any time by written notice to the Contractor when it is in the RVTD's best interest. The Contractor shall be paid its costs, including contract close-out costs, and profit on work performed up to the time of termination. The Contractor shall promptly submit its termination claim to RVTD to be paid the Contractor. If the Contractor has any property in its possession belonging to RVTD, the Contractor will account for the same, and dispose of it in the manner RVTD directs.

Termination for Default Breach or Cause (General Provision)

If the Contractor does not deliver supplies in accordance with the contract delivery schedule, or if the contract is for services, the Contractor fails to perform in the manner called for in the contract, or if the Contractor fails to comply with any other provisions of the contract, the RVTD may terminate this contract for default. Termination shall be affected by serving a Notice of Termination on the Contractor setting forth the manner in which the Contractor is in default. The Contractor will be paid only the contract price for supplies delivered and accepted, or services performed in accordance with the manner of performance set forth in the contract.

If it is later determined by the RVTD that the Contractor had an excusable reason for not performing, such as a strike, fire, or flood, events which are not the fault of or are beyond the control of the Contractor, the RVTD, after setting up a new delivery of performance schedule, may allow the Contractor to continue work, or treat the termination as a Termination for Convenience.

Opportunity to Cure (General Provision)

The RVTD, in its sole discretion may, in the case of a termination for breach or default, allow the Contractor [an appropriately short period of time] in which to cure the defect. In such case, the Notice of Termination will state the time period in which cure is permitted and other appropriate conditions.

If Contractor fails to remedy to RVTD's satisfaction the breach or default of any of the terms, covenants, or conditions of this Contract within [10 days] after receipt by Contractor of written notice from RVTD setting forth the nature of said breach or default, RVTD shall have the right to terminate the contract without any further obligation to Contractor. Any such termination for default shall not in any way operate to preclude RVTD from also pursuing all available remedies against Contractor and its sureties for said breach or default.

Waiver of Remedies for any Branch

In the event that RVTD elects to waive its remedies for any breach by Contractor of any covenant, term or condition of this contract, such waiver by RVTD shall not limit RVTD's remedies for any succeeding breach of that or of any other covenant, term, or condition of this contract.

Termination for Default (Construction)

If the Contractor refuses or fails to prosecute the work or any separable part, with the diligence that will ensure its completion within the time specified in this contract or any extension or fails to complete the work within this time, or if the Contractor fails to comply with any other provision of this contract, RVTD may terminate this contract for default. The RVTD shall terminate by delivering to the Contractor a Notice of Termination specifying the nature of the default. In this event, the RVTD may take over the work and complete it by contract or otherwise, and may take possession of and use any materials, appliances, and plant on the work site necessary for completing the work. The Contractor's refusal or failure to complete the work within the specified time, whether or not the Contractor's right to proceed with the work is terminated. This liability includes any increased costs incurred by the RVTD in completing the work.

The Contractor's right to proceed shall not be terminated nor shall the Contractor be charged with damages under this clause if:

 The delay in completing the work arises from unforeseeable causes beyond the control and without the fault or negligence of the Contractor. Examples of such causes include: acts of God, acts of RVTD, acts of another contractor in the performance of a contract with RVTD, epidemics, quarantine restrictions, strikes, freight embargoes; and

2. The Contractor, within [10] days from the beginning of any delay, notifies RVTD in writing of the causes of delay. If, in the judgment of RVTD, the delay is excusable, the time for completing the work shall be extended. The judgment of RVTD shall be final and conclusive for the parties, but subject to appeal under the Disputes clause(s) of this contract.

If, after termination of the Contractor's right to proceed, it is determined that the Contractor was not in default, or that the delay was excusable, the rights and obligations of the parties will be the same as if the termination had been issued for the convenience of RVTD.

VIOLATION AND BREACH OF CONTRACT

2 C.F.R. § 200.326 2 C.F.R. part 200, Appendix II (A)

Rights and Remedies of the RVTD

- 1. The right to take over and complete the work or any part thereof as RVTD for and at the expense of the Contractor, either directly or through other contractors;
- 2. The right to cancel this Contract as to any or all of the work yet to be performed;
- 3. The right to specific performance, an injunction or any other appropriate equitable remedy; and
- 4. The right to money damages.

Rights and Remedies of Contractor

Inasmuch as the Contractor can be adequately compensated by money damages for any breach of this Contract, which may be committed by the RVTD, the Contractor expressly agrees that no default, act or omission of the RVTD shall constitute a material breach of this Contract, entitling Contractor to cancel or rescind the Contract (unless the RVTD directs Contractor to do so) or to suspend or abandon performance.

Remedies

Substantial failure of the Contractor to complete the Project in accordance with the terms of this Agreement will be a default of this Agreement. In the event of a default, the RVTD will have all remedies in law and equity, including the right to specific performance, without further assistance, and the right to termination or suspension as provided herein. The Contractor recognizes that in the event of a breach of this Agreement by the Contractor before the RVTD takes action contemplated herein, the RVTD will provide the Contractor with sixty (60) days written notice that the RVTD considers that such a breach has occurred and will provide the Contractor a reasonable period of time to respond and to take necessary corrective action.

Disputes

RVTD and the Contractor intend to resolve all disputes under this Agreement to the best of their abilities in an informal manner. To accomplish this end, the parties will use an Alternative Dispute Resolution process to resolve disputes in a manner designed to avoid litigation. In general, the parties contemplate that the Alternative Dispute Resolution process will include, at a minimum, an attempt to resolve disputes through communications between their staffs, and, if resolution is not reached at that level, a procedure for review and action on such disputes by appropriate management level officials within the RVTD and the Contractor's organization.

In the event that a resolution of the dispute is not mutually agreed upon, the parties can agree to mediate the dispute or proceed with litigation. Notwithstanding any provision of this section, or any other provision of this Contract, it is expressly agreed and understood that any court proceeding arising out of a dispute under the Contract shall be heard by a Court de novo and the court shall not be limited in such proceeding to the issue of whether the Authority acted in an arbitrary, capricious or grossly erroneous manner.

Pending final settlement of any dispute, the parties shall proceed diligently with the performance of the Contract, and in accordance with the RVTD's direction or decisions made thereof.

Performance during Dispute

Unless otherwise directed by RVTD, Contractor shall continue performance under this Contract while matters in dispute are being resolved.

Claims for Damages

Should either party to the Contract suffer injury or damage to person or property because of any act or omission of the party or of any of its employees, agents or others for whose acts it is legally liable, a claim for damages therefor shall be made in writing to such other party within a reasonable time after the first observance of such injury or damage.

Remedies

Unless this Contract provides otherwise, all claims, counterclaims, disputes and other matters in question between the RVTD and the Contractor arising out of or relating to this agreement or its breach will be decided by arbitration if the parties mutually agree, or in a court of competent jurisdiction within the State in which the RVTD is located.

Rights and Remedies

The duties and obligations imposed by the Contract documents and the rights and remedies available thereunder shall be in addition to and not a limitation of any duties, obligations, rights and remedies otherwise imposed or available by law. No action or failure to act by the RVTD or Contractor shall constitute a waiver of any right or duty afforded any of them under the Contract, nor shall any such action or failure to act constitute an approval of or acquiescence in any breach thereunder, except as may be specifically agreed in writing.

REQUIRED FORMS

BUY AMERICA

49 U.S.C. 5323(j) 49 C.F.R. part 661

The contractor agrees to comply with 49 U.S.C. 5323(j) and 49 C.F.R. part 661, which provide that Federal funds may not be obligated unless all steel, iron, and manufactured products used in FTA funded projects are produced in the United States, unless a waiver has been granted by FTA or the product is subject to a general waiver. General waivers are listed in 49 C.F.R. § 661.7. Separate requirements for rolling stock are set out at 49 U.S.C. 5323(j)(2)(C) and 49 C.F.R. § 661.11.

The bidder must submit to RVTD the appropriate Buy America certification below with its bid. Bids that are not accompanied by a completed Buy America certification will be rejected as nonresponsive. In accordance with 49 C.F.R. § 661.6, for the procurement of steel, iron or manufactured products, use the certifications below.

Certificate of Compliance with Buy America Requirements

The bidder or offeror hereby certifies that it will comply with the requirements of 49 U.S.C. 5323(j)(1), and the applicable regulations in 49 C.F.R. part 661.

Date:	
Signature:	
Company:	
Name:	
Title:	

Certificate of Non-Compliance with Buy America Requirements

The bidder or offeror hereby certifies that it cannot comply with the requirements of 49 U.S.C. 5323(j), but it may qualify for an exception to the requirement pursuant to 49 U.S.C. 5323(j)(2), as amended, and the applicable regulations in 49 C.F.R. § 661.7.

Date:		
Signature:		
Company:		
Name:		
Title:		
RVTD Transportation Building Construction Documents – Issue for Bid 05.15.2023	00 0073 - 26	SUPPLEMENTARY CONDITIONS
Certificate Regarding Lobbying

Certification for Contracts, Grants, Loans, and Cooperative Agreements

(To be submitted with each bid or offer exceeding \$100,000)

The undersigned Contract certifies, to the best of his or her knowledge and belief that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for making lobbying contacts to an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form--LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions [as amended by "Government-wide Guidance for New Restrictions on Lobbying," 61 Fed. Reg. 1413 (1/19/96).

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of the fact upon which reliance was placed when this transaction was made entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31 U.S.C. § 1352 (as amended by the Lobbying Disclosure Act of 1995). Any person who fails to file the required shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

The Contractor, ______, certifies or affirms the truthfulness and accuracy of each statement of its certification and disclosure, if any. In addition, the Contractor understands and agrees that the provisions of 31 U.S.C. 3801, et. seq., apply to this certification and disclosure, if any.

	Signature of Contractor's Authorized Official	
	Name and Title of Contractor's Authorized Offic	ial
	Date	
DVTD Transportation Building	00 0073 - 27	SUPPLEMENTA

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CERTIFICATION OF PRIMARY PARTICIPANT REGARDING DEBARMENT, SUSPENSION, AND OTHER RESPONSIBILITY MATTERS

The Primary Participant ______ certifies to the best of its knowledge and belief, that it and its principals:

1. Are not presently debarred, suspended, proposed for debarment, declared ineligible or voluntarily excluded from covered transactions by any Federal department or agency.

2. Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction, violation of Federal or State anti-trust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

3. Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (2) of this certification; and

4. Have not within the three-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.

Where the Contractor is unable to certify to any of the statements in this certification, the participant shall attach an explanation to this certification.

Contractor (name) ______ CERTIFIES OR AFFIRMS THE TRUTHFULNESS AND ACCURACY OF THE CONTENTS OF THE STATEMENTS SUBMITTED ON OR WITH THIS CERTIFICATION AND UNDERSTANDS THAT THE PROVISIONS OF 31 U.S.C. SECTIONS 3801 ET. SEQ. ARE APPLICABLE THERETO.

Dun & Bradstreet Number:_____

(Must be an active D&B # registered with the System for Award Management (<u>www.sam.gov</u>)

Date:______ Authorized Official: ______

Signature:_____

Disadvantaged Business Enterprise Certification

NOTE: please check one of the below options.

_____ The Bidder/Offeror hereby agrees to subcontract a minimum of .75% of the contract to disadvantaged business enterprises.

_____ The Bidder/Offeror (if unable to meet the DBE goal of .75%) is committed to a minimum of ______% DBE utilization on this contract and submits documentation demonstrating good faith efforts.

_____ The Bidder/Offeror will not participate in DBE participation.

DBE PARTICIPATION SCHEDULE

The Bidder/Offeror shall complete the following information in the table provided below for all DBE's participating in the contract.

That comprises the DBE Utilization percent stated in the DEB Utilization Form. The Bidder/Offeror shall also furnish the name and telephone number of the appropriate contact person should the Authority have any questions in relation to the information furnished herein.

Name and Address	Contact Name and Telephone Number	Participation Percent (Of Total Contract Value)	Description of Work to Be Performed	Race and/or Gender of Firm

DBE IDENTIFICATION AND INFORMATION FORM

(Failure to complete these forms may render this bid non-responsive).

SECTION 00 7316 INSURANCE REQUIREMENTS

PART 1 GENERAL

1.01 INSURANCE REQUIREMENTS

A. The Contractor shall provide Insurance in the type and amounts listed on the INSURANCE COVERAGES REQUIRED form bound hereinafter In Section 00 7317.

1.02 FORM OF CERTIFICATION

A. The certification of the type and amounts of Insurance shall be executed on ACCORD A-25 STANDARD CERTIFICATE OF INSURANCE.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

SECTION 00 7317

INSURANCE COVERAGE REQUIRED FORM

PART 1

1.01 COVERAGE PRIOR TO COMMENCEMENT OF WORK

A. Contractor shall not commence any work until contractor obtains, at contractor's own expense, all required insurance as specified below. Such insurance must have the approval of the owner as to limits, form and amount. The types of insurance contractor is required to obtain or maintain for the full period of the contract will be as specified below.

1.02 COMMERCIAL GENERAL LIABILITY COVERAGE

A. The Contractor shall provide Commercial General Liability insurance covering personal injury, bodily injury and property damage with limits as specified below. The insurance shall also include:

B. Coverages

- 1. Explosion & Collapse
- 2. Underground Hazard
- 3. Contractual Liability
- 4. Broad Form Property Damage
- 5. Owners' & Contractors' Protective
- 6. Commercial General Liability
- 7. Damage to Rented Property (\$50,000)
- 8. Personal and Advertising (Same as per occurrence)
- 9. Products/Completed Operations (Same as per occurrence)
- C. Limits
 - 1. \$2 million per occurrence / \$4 million aggregate.
- D. Aggregate Limits
 - 1. Per Project (construction contracts)
- E. Form
 - 1. All policies must be of the occurrence form with combined single limit for bodily injury and property damage.

1.03 AUTOMOBILE LIABILITY

- A. Contractor shall carry Automobile Liability insurance with limits as specified below. The coverage shall include owned, hired and non-owned automobiles.
- B. Limits
 - 1. \$2 million combined single limit per accident for bodily injury and property damage.

1.04 ADDITIONAL INSURED ENDORSEMENT

A. Both general and automobile liability insurance policies must be endorsed to name RVTD, its officers, agents, employees and volunteers as additional insureds with respect to the Contractor's activities being performed under the Contract. The additional insureds must be named as additional insured by separate endorsement, and the Endorsement must be attached with the Certificate of Insurance.

1.05 WORKERS' COMPENSATION AND EMPLOYER'S LIABILITY INSURANCE

- A. Contractor shall carry Workers' Compensation and Employer's Liability insurance as statutorily required for persons performing work under this contract. Any subcontractor hired by Contractor shall also carry Workers' Compensation and Employers' Liability coverage.
- B. Employer's Liability
 - 1. Limits of \$500,000

1.06 BUILDER'S RISK INSURANCE SPECIAL FORM.

A. Contractor shall carry the Builder's "All-Risk" or equivalent policy, with limits equal to the value of the contract plus the value of subsequent contract modifications.

SECTION 00 7343 PREVAILING WAGE RATES

PART 1 GENERAL

1.01 MINIMUM WAGE RATES

- A. The minimum wage rates to be paid all crafts and labor on this contract shall be the prevailing wage for the individual crafts involved in the Jackson County area during the life of the contract and as determined by the Commissioner of the Oregon Bureau of Labor and Industries, along with conformance to ORS 279C, as may be applicable to the supplying of the services and/or materials called for in the bid.
- B. Every contractor and subcontractor shall pay workers not less than the specified minimum hourly rate of wage for each trade or occupation in each locality.
- C. Each worker in each trade or occupation employed in the performance of the contract either by the contractor, subcontractor or other person doing or contracting to do or contracting for the whole or any part of the work on the contract, must be paid not less than the applicable state prevailing rate of wage in accordance with ORS 279C.383 and 279C.840, or the applicable federal prevailing rate of wage, whichever is higher.

1.02 GENERAL REQUIREMENTS

- A. If a dispute arises as to what the prevailing wage rate for any class of worker is, and if the dispute cannot be settled by the parties involved, it may be referred to the Commission of the Bureau of Labor and Industries, State of Oregon, for final determination. The Wage Rates are minimum rates only and the Owner will not consider any claims or additional compensation because of payment made by Contractor or a Sub-Contractor of any wage rate in excess of the prevailing rate.
- B. Prevailing Wage Rates:
 - 1. Prevailing wage rates in compliance with Davis Bacon Act for public works and construction contracts are required for this project. No bid will be received or considered by RVTD unless the bid contains a statement that the Bidder will comply with the provisions of ORS 279C.800 to 279C.840 and 49 U.S.C. § 5333(a), Davis-Bacon Act regarding the payment of prevailing rates of wage.
 - 2. It is the responsibility of contractor to use published rates for Davis Bacon and BOLI Rates. The higher of the two rates shall apply.
 - 3. Applicable rates shall be those in effect at the time of the Advertisement for Bids.
- C. If the Owner determines at any time that the prevailing rate of wages has not or is not being paid as required herein, it may retain from moneys due to Contractor an amount sufficient to make up the difference between wages actually paid and the prevailing rate of wages, and may also cancel the contract.
- D. Liquidated damages for failure to pay the rate of wage required herein will be an additional amount equal to the unpaid minimum, over and above the liability of the Contractor, any Subcontractor, or surety to pay said unpaid minimum to any workers affected.

1.03 POSTING MINIMUM WAGE RATES

- A. The Contractor and each subcontractor must post and maintain the prevailing rates of wage for this project for the Project duration in a conspicuous location accessible to employees
- B. If the Contractor or any subcontractor that provides or contributes to a health and welfare plan or a pension plan, or both, for the contractor or subcontractor's employees on the project, must post a notice in a conspicuous and accessible place in or about the project describing the plan and containing information on how and where to make claims and where to obtain further information.

1.04 NOTICE OF CONTRACT AWARD

A. The Owner will send a copy of the Notice of Award of Public Works Contract Form to the State of Oregon Bureau of Labor and Industries.

1.05 WAGE CERTIFICATION

- A. In accordance with the requirements printed in the document titled "Prevailing Wage Rates for Public Works Contracts in Oregon", the Owner, upon written request from the Contractor, will provide the Contractor with a sample copy of the Payroll Submission Form to be used on this project. Contractors shall use their own copies of this form in their reporting, or may submit a pre-approved substitute form of their own choosing that meets the reporting requirements of the Bureau of Labor and Industries.
- B. Under the provisions of Oregon Law, ORS 279C.845, the wage certification Payroll Submission Form on public works contracts must be provided to the Owner in accordance with the following schedule:
 - 1. Once within 15 days of the date the Contractor or Subcontractor first began work on the project, and,
 - 2. Once before the final inspection of the project by the Owner, and,
 - 3. In addition, certified statements for each week during which the contractor or subcontractor employs a worker upon the work must be submitted once a month, by the fifth business day of the following month.

1.06 MAINTAINING & DISTRIBUTION OF CERTIFIED PAYROLL STATEMENTS

A. Certified Payroll Statements are public records and are to be filed by the Contractor with the Owner, and must be kept by the Contractor and/or Subcontractor. Certified Payroll Statements must be made available upon request.

1.07 PAYMENT OF PREVAILING WAGE RATES

A. If a contractor is required to file certified payroll statements and fails to do so, the Owner may retain 25 percent of any amount earned by the Contractor on the contract until the Contractor has filed such statements with the Owner. The Owner will pay the Contractor the amount retained under this provision within 14 days after the Contractor files the certified statements, regardless of whether a subcontractor has failed to file such statements. The Contractor must retain 25 percent of any amount earned by a first-tier subcontractor on a public works until the subcontractor has filed with the Owner certified statements as required by this provision. The Contractor must verify that the first-tier subcontractor has filed the certified statements before the contractor may pay the subcontractor any amount retained under this provision. The Contractor must pay the first-tier subcontractor the amount retained under this provision within 14 days after the subcontractor files the certified statements. The amount retained under this provision within 14 days after the subcontractor files the certified statements. The amount retained under this provision within 14 days after the subcontractor files the certified statements. The amount retained under this provision within 14 days after the subcontractor files the certified statements. The amount retained under this provision within 14 days after the subcontractor files the certified statements. The amount retained under this provision is in addition to any other amount permitted to be retained by ORS 279C, including the 5% from any progress payment to ensure satisfactory progress under ORS 279C.570(7).

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

SECTION 01 1000 SUMMARY

PART 1 GENERAL

1.01 PROJECT

- A. Project Name: RVTD Transportation Building
- B. The Project consists of the construction of a two-story, wood-framed, approximately 10,000 square foot office building and a 88 stall, two-story, concrete parking garage sited on a 1.34 acre vacant parcel. The site is directly south of property currently housing RVTD's primary operations and is accessed off Forest Hills Drive in Medford, Oregon.

1.02 CONTRACT DESCRIPTION

A. Contract Type: A single prime contract based on a Stipulated Price as described in Document 00 5200 - Agreement Form.

1.03 DESCRIPTION OF ALTERATIONS WORK

A. Scope of demolition and removal work is indicated on drawings and specified in Section 02 4100.

1.04 WORK BY OWNER

- A. Items noted OFOI (Owner-Furnished, Owner-Installed) will be supplied and installed by Owner before Date of Substantial Completion. Some items include:
 - 1. Movable cabinets.
 - 2. Furnishings.
 - 3. Access Control Devices.
 - 4. Security Devices.
- B. Owner will supply the following for installation by Contractor:
 - 1. Appliances, as indicated on drawings.

1.05 OWNER OCCUPANCY

- A. Owner intends to occupy the Project upon Substantial Completion.
- B. Owner intends to occupy the existing facilities to the north of the site prior to the completion date for the conduct of normal operations.
- C. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- D. Schedule the Work to accommodate Owner occupancy.

1.06 CONTRACTOR USE OF SITE AND PREMISES

- A. Arrange use of site and premises to allow:
 - 1. Owner occupancy.
- B. Provide access to and from site as required by law and by Owner:
 - 1. Do not obstruct roadways, sidewalks, or other public ways without permit.
 - 2. Construction access shall be from Forest Hills Drive.
- C. Utility Outages and Shutdown:
 - 1. Limit shutdown of utility services to agreed hours, arranged at least 24 hours in advance with Owner.
 - 2. Prevent accidental disruption of utility services to other facilities.
- D. Except as otherwise stipulated herein, Contractors will have complete use of the Premises within the boundaries of the project as shown on the Drawings for the execution of the Work.
- E. The possession, use, or distribution of illicit drugs and alcohol on the Owner's premises is prohibited. Prescription medications brought to the project site shall be in the original container bearing the name of the drug, the name of the physician, the name of the patient, and the prescribed dosage.

- F. NO SMOKING POLICY: Unless noted elsewhere, smoking is not allowed within buildings once gypsum board installation has commenced.
- G. Tools and building materials shall never be left out when an unsecured work area is vacated.
- H. Ladders and scaffolding shall be taken down when an unsecured work area is vacated.
- I. Open holes and other tripping hazards shall be fenced or barricaded when an unsecured work area is vacated.
- J. "Secured Work Area" is defined as an exterior area having a perimeter cyclone fence at least 6 feet in height, with gates which close and lock so that no casual entrance is possible by unauthorized personnel, or an interior area protected by locked doors that reasonably prohibit unauthorized entry.
- K. Operations resulting in vapors, emissions or flying objects shall be conducted in such a way as to prevent exposure to any unprotected parties or property.

1.07 COORDINATION AND PERMITS

- A. Coordination
 - 1. The Contractor is responsible for overall coordination of the Project.
 - 2. The Drawings and Specifications are arranged for convenience only and do not necessarily determine which trades perform the various portions of the Work.
 - 3. Coordinate sequence of work to accommodate agreed-upon Owner occupancy.
 - 4. Perform all necessary work to receive and/or join the work of all trades.
 - 5. Verify location of existing utilities and protect from damage.
- B. Permits and Fees
 - 1. The Owner will be responsible for filing and paying for building permits and all fees associated with the building permit, system development charges, impact fees, etc. The Contractor will be responsible for picking up all Project permits and will have full responsibility for requirements of and payments for all trade permits (i.e. electrical, plumbing, mechanical).

1.08 DELEGATED DESIGN REQUIREMENTS

- A. Certain components of the Work under this project are Delegated Design. It is the Contractor's responsibility to coordinate and assume or assign to subcontractors the complete responsibilities for the design, calculation, submittals, fabrication, transportation and installation of the Delegated Design portions or components as required. Delegated Design components of the Work are defined as complete operational systems, provided for their intended use.
- B. Submit deferred submittals for delegated design elements to the governing agency for the separate approval of each Delegated Design item as defined in Section 01 3000 Administrative Requirements.
- C. Owner shall not be responsible to pay for any delays, additional products, additional hours of work or overtime, restocking or rework required due to failure by the Contractor or the subcontractor to coordinate their work with the work of the other trades on the project or to provide the Delegated Design portion or component in a timely manner to meet the schedule of the project.
- D. Delegated Design components include, but are not limited to the following:
 - 1. Pre-cast Structural Concrete, Section 03 4100.
 - 2. Fall Arrest System, Section 07 7273 Fall Arrest Roof Anchors.
 - 3. Firestopping, Section 07 84 00 Firestopping.
 - 4. Aluminum Storefront, Section 08 4313 Aluminum-Framed Storefronts.
 - 5. Seismic Anchorage for Suspended Acoustical Ceilings, Section 09 5100 Acoustical Ceilings.
 - 6. Seismic Anchorage Divisions 21, 23, 26, 27 and 28 equipment, hoods, panels and other components of mechanical, plumbing, gas and electrical systems.
 - 7. Fire Suppression, Division 21.

- 8. Fire Alarm System, Division 28.
- 9. Photovoltaic panels and support structure, Section 26 3100.
- 10. Additional requirements from specific specification sections in this Project Manual and as shown on the Drawings.

1.09 DUST PROTECTION AND SAFETY BARRIERS

- A. The Contractor shall place and maintain throughout the construction period, High-tack Disposable Floor Mats at all construction egress points leading to finished spaces.
- B. The Contractor shall erect temporary Dust and Safety Barriers around all of the Construction Operations to keep dust and debris within the localized work area, and to protect the owner, staff, and the public from construction activities. Additional requirements may be required if airborne dust is judged by the Owner to be a problem.

1.10 WORK IN PUBLIC RIGHT-OF-WAY

A. The Contractor shall obtain any required Permits, pay Permit Fees, arrange for inspections by Regulatory Agencies, and comply with governing Regulatory Agency requirements.

1.11 PROTECTING EXISTING UTILITIES

- A. Site Survey Drawings indicate approximate location of any known, concealed Utility Lines. Before starting work, Contractor shall determine exact location of any of these Lines that could be damaged by Contract Work.
- B. Contractor shall assume that other unknown Utility Lines do exist, and Contractor shall proceed with caution when working in areas that could conceal unknown Utilities.
- C. If such Utility Lines are encountered, immediately request disposition instructions from Architect.
- D. If Utility Lines are damaged; remove, repair, or replace Lines as directed. Additional compensation and/or extension of time, if any, caused by removing, repairing, or replacing Lines will be determined in accordance with General Conditions.

1.12 PROTECTING EXISTING LANDSCAPING & TREES

- A. Protect existing Trees, not designated for removal, against damage caused by work of this contract.
- B. Prohibit Earth stockpiling, Material storage, and Vehicle Parking and Traffic within Drip-line of Trees.
- C. Prohibit dumping of Refuse, Chemicals, and other Materials and puddling or running Water which may injure Plant growth including Root systems.
- D. Prohibit Foot and Vehicle Traffic which may compact Soil over Root Systems.

1.13 PROTECTING EXISTING SUBGRADE

- A. Contractor shall protect existing Subgrade and Earthwork against damage caused by work provided under this Contract.
- B. Where necessary to accomplish required protection, provide additional Temporary Fill or other approved Cover over Work to be protected.

1.14 WORK SEQUENCE

- A. Construct Work in phases during the construction period:
 - 1. Phase 1: Work on the Transportation Building site including Parking Garage, Transportation Building, and associated site work.
 - 2. Phase 2: Utility work on the existing RVTD site including data and sanitary sewer connections.
 - a. Work in this Phase may be concurrent to the Work of Phase 1.
 - b. Coordinate timing and duration of work to minimize disruptions to existing operations.
 - c. Provide temporary trench coverings as required to maintain bus operations on the site.

B. Coordinate construction schedule and operations with Owner.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

SECTION 01 2000 PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedures for preparation and submittal of applications for progress payments.
- B. Documentation of changes in Contract Sum and Contract Time.
- C. Change procedures.
- D. Correlation of Contractor submittals based on changes.
- E. Procedures for preparation and submittal of application for final payment.
- F. Schedule of Values
- G. Payments for products stored off site.

1.02 RELATED REQUIREMENTS

- A. Section 00 5200 Agreement Form: Contract Sum, retainages, payment period, monetary values of unit prices.
- B. Section 00 7200 General Conditions: Additional requirements for progress payments, final payment, changes in the Work.
- C. Section 00 7343 Prevailing Wage Rates
- D. Section 01 7800 Closeout Submittals: Project record documents.

1.03 SCHEDULE OF VALUES

- A. Use Schedule of Values Form: AIA G703, edition stipulated in the Agreement.
- B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.
- C. Forms filled out by hand will not be accepted.
- D. Submit Schedule of Values in PDF format within 15 days after date of Owner-Contractor Agreement.
 - 1. The purpose of the preliminary draft is to confirm the level of detail required by the Design Team, and the Contractor is to make adjustments as requested. The Architect will not review any Application submitted until changes requested by the Architect to the preliminary draft have been incorporated.
- E. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification section.
 - 1. Specifically identify amounts for products stored off-site, and the additional siupporting documentation.
- F. Revise schedule to list approved Change Orders, with each Application For Payment.
- G. Round off values to nearest dollar.
- H. Sum of values listed shall equal total Contract Sum.
- I. Substantiating Data: When requested by Architect, submit justifying Substantiating Data and Line Item Amounts in question.

1.04 APPLICATIONS FOR PROGRESS PAYMENTS

- A. Payment Period: Monthly.
- B. Use Form AIA G702 and Form AIA G703, edition stipulated in the Agreement.
- C. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.
- D. Forms filled out by hand will not be accepted.
- E. Execute certification by signature of authorized officer.

- F. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
- G. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of Work. Include individual line items for change orders involving multiple items.
- H. Submit one digital copy in PDF format of each Application for Payment.
- I. Include the following with the application:
 - 1. Construction progress schedule, revised and current as specified in Section 01 3000.
 - 2. Affidavits attesting to off-site stored products.
- J. When Architect requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.
- K. Submit Applications for Payment to Architect at times stipulated below.
- L. When Architect finds Application properly completed and correct, Architect will transmit 1 digital copy of Certificate for Payment to Owner for approval of payment, with a copy to Contractor, and one retained for files.

1.05 ALTERNATE CONSTRUCTION PAYMENT MANAGEMENT SYSTEMS:

- A. Nothing contained herein would prohibit the Contractor from proposing the use of a Construction Payment Management System that substantially complies with the requirements of this section. The contractor shall pay all additional fees associated with the Owner and Architect's use of this system.
- B. Pre-Approved Systems:
 - 1. Textura Construction Payment Management: https://cpm.texturacorp.com

1.06 PAYMENT FOR PRODUCTS STORED OFF THE PROJECT SITE

- A. When delay or added cost to Owner can be avoided by storing Products off Site, Owner will make payment to Contractor for said Products provided that
- B. Contractor shall:
 - 1. Locate Storage Facilities within 20 miles of the Architect's Office or the Project Site.
 - 2. Make Storage Facilities available for Architect's visual inspection.
 - 3. Segregate and label Stored Products for specified Project.
 - 4. Assume all risk for loss.
 - 5. Assume responsibility for exceeding Product "Shelf-Life".
 - 6. Protect Stored Products and provide applicable Insurance against their damage, discoloration, and theft, listing the Owner and any Mortgagee as Additional Named Insured.
 - 7. Submit itemized Inventory and Schedule of Values for Stored Products together with Certificate of Insurance.
 - 8. Submit payment requests to Owner as part of Contractor's regular Progress Payment Request.
 - 9. Reimburse Owner for damages sustained if Stored Products are not delivered to Jobsite when needed.
 - 10. Submit to Owner, with copy to Architect, a written Waiver of Lien insuring Owner against claims for unpaid Storage Costs.
 - 11. Upon receipt of payment from Owner, prepare and issue to Owner, with a copy for Architect, and any Mortgagee, a Bill of Sale for Stored Products.

1.07 DOWNPAYMENTS

A. The Owner will not approve or pay for any down payment for materials or services that may be requested by suppliers or subcontractors.

1.08 PREVAILING WAGE PAYMENT CERTIFICATION

A. Submit Prevailing Wage Payment Certification Forms as required by Section 00 7343.

1.09 APPLICATION PAYMENT SCHEDULE

- A. Regular monthly Applications for Payment submitted by the Contractor will be paid by Owner within 30 Days following Owner's approval of payment of in-order Application for Payment.
 - 1. Until Substantial Completion, the Owner will pay Ninety-Five Percent (95%) of the approved payment request, as defined in General Conditions, for work completed during the previous month, as certified by the Architect.
- B. After execution of Certificate of Substantial Completion, and within 30 days, following Owner's approval of payment of the next in-order Application for Payment, the Owner will pay:
 - 1. Balance due under Contract, excluding a Retainage Amount of at least \$1,000, or double the estimated value of uncompleted and/or unacceptable portions of Work, whichever is the greater amount.
- C. Thirty (30) days after final inspection and acceptance by Owner, and within 30 days following Owner's approval of payment of final in-order Application for Payment, the Owner will pay:
 - 1. Balance due under Contract, provided Work be then fully completed and Contract be then fully performed.

1.10 MODIFICATION PROCEDURES

- A. Submit name of the individual authorized to receive change documents and who will be responsible for informing others in Contractor's employ or subcontractors of changes to Contract Documents.
- B. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.
- C. For other required changes, Architect will issue a Construction Change Directive document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
 - 1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
 - 2. Promptly execute the change.
- D. For changes for which advance pricing is desired, Architect will issue a Proposal Request document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 7 calendar days.
- E. Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation. Document any requested substitutions in accordance with Section 01 6000.
- F. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
 - 1. For change requested by Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
 - 2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Architect.
 - 3. For pre-determined unit prices and quantities, the amount will based on the fixed unit prices.
 - 4. For change ordered by Architect without a quotation from Contractor, the amount will be determined by Architect based on the Contractor's substantiation of costs as specified for Time and Material work.

- G. Substantiation of Costs: Provide full information required for evaluation.
 - 1. Provide the following data:
 - a. Quantities of products, labor, and equipment.
 - b. Taxes, insurance, and bonds.
 - c. Overhead and profit.
 - d. Justification for any change in Contract Time.
 - e. Credit for deletions from Contract, similarly documented.
 - 2. Support each claim for additional costs with additional information:
 - a. Origin and date of claim.
 - b. Dates and times work was performed, and by whom.
 - c. Time records and wage rates paid.
 - d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.
 - 3. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.
- H. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.
- I. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.
- J. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
- K. Promptly enter changes in Project Record Documents.

1.11 APPLICATION FOR FINAL PAYMENT

- A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- B. Application for Final Payment will not be considered until the following have been accomplished:
 - 1. All closeout procedures specified in Section 01 7000.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

SECTION 01 2500 SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

- A. Section 00 2113 Instructions to Bidders: Restrictions on timing of substitution requests.
- B. Section 01 6000 Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.
- C. Section 01 6023 Substitution Request Form

1.03 DEFINITIONS

- A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
 - 1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
 - a. Unavailability.
 - b. Regulatory changes.
 - 2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
 - a. Substitution requests offering advantages solely to the Contractor will not be considered.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
 - 2. Agrees to provide the same warranty for the substitution as for the specified product.
 - 3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
 - 4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
 - 5. Waives claims for additional costs or time extension that may subsequently become apparent.
 - 6. Agrees to reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.
- B. A Substitution Request for specified installer constitutes a representation that the submitter:
 - 1. Has acted in good faith to obtain services of specified installer, but was unable to come to commercial, or other terms.
- C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
 - 1. Note explicitly any non-compliant characteristics.
- D. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
 - Forms indicated in the Project Manual are adequate for this purpose, and must be used.
 - a. Substitution Request Information:
 - 1) Indication of whether the substitution is for cause or convenience.
 - 2) Issue date.

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- 3) Reference to particular Contract Document(s) specification section number, title, and article/paragraph(s).
- 4) Description of Substitution.
- 5) Reason why the specified item cannot be provided.
- 6) Differences between proposed substitution and specified item.
- 7) Description of how proposed substitution affects other parts of work.
- b. Impact of Substitution:
 - 1) Savings to Owner for accepting substitution.
 - 2) Change to Contract Time due to accepting substitution.
- E. Limit each request to a single proposed substitution item.

3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT

- A. Submittal Time Restrictions:
 - 1. Instructions to Bidders specifies time restrictions and the documents required for submitting substitution requests during the bidding period.
- B. Submittal Form (before award of contract):
 - 1. Submit Substitution Request Form in Section 01 6023.

3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

- A. Submittal Form (after award of contract):
 - 1. Submit Substitution Request Form in Section 01 6023.
- B. Submit request for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
- C. Submit request for Substitution for Convenience immediately upon discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
 - 1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
 - 2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
 - 3. Bear the costs engendered by proposed substitution of:
 - a. Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.
 - b. Other construction by Owner.
 - c. Other unanticipated project considerations.
- D. Substitutions will not be considered under one or more of the following circumstances:
 - 1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
 - 2. Without a separate written request.
 - 3. When acceptance will require revisions to Contract Documents.

3.04 RESOLUTION

- A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.
- B. Architect will notify Contractor in writing of decision to accept or reject request.
 - 1. Architect's decision following review of proposed substitution will be noted on the submitted form.

3.05 ACCEPTANCE

A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive,

Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

3.06 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 Closeout Submittals, for closeout submittals.
- B. Include completed Substitution Request Forms as part of the Project record. Include both approved and rejected Requests.

SECTION 01 3000 ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General administrative requirements.
- B. Electronic document submittal service.
- C. Preconstruction meeting.
- D. Progress meetings.
- E. Coordination drawings.
- F. Submittals for review, information, and project closeout.
- G. Number of copies of submittals.
- H. Requests for Information (RFI) procedures.
- I. Submittal procedures.

1.02 RELATED REQUIREMENTS

- A. Section 01 6000 Product Requirements: General product requirements.
- B. Section 01 7000 Execution and Closeout Requirements: Additional coordination requirements.
- C. Section 01 7800 Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.

1.03 GENERAL ADMINISTRATIVE REQUIREMENTS

- A. Conform to requirements of Section 01 7000 Execution and Closeout Requirements for coordination and execution of administrative tasks with timing of construction activities.
- B. Make the following types of submittals to Architect:
 - 1. Requests for Information (RFI).
 - 2. Requests for substitution.
 - 3. Shop drawings, product data, and samples.
 - 4. Test and inspection reports.
 - 5. Design data.
 - 6. Manufacturer's instructions and field reports.
 - 7. Applications for payment and change order requests.
 - 8. Progress schedules.
 - 9. Coordination drawings.
 - 10. Correction Punch List and Final Correction Punch List for Substantial Completion.
 - 11. Closeout submittals.

1.04 CONSTRUCTION ORGANIZATION & START-UP

- A. Responsible Parties:
 - 1. Immediately following Contract execution, Owner and Contractor shall each identify who, within their respective organizations, will be responsible for Project Coordination.
- B. The Contractor shall establish on-site Lines of Authority and Communications including the following:
 - 1. Schedule attendance at Preconstruction Meeting and schedule and conduct Progress Meetings as specified in herein.
 - 2. Establish procedures for Intra-project Communications including:
 - a. Submittals.
 - b. Reports & Records.
 - c. Recommendations.
 - d. Coordination Drawings.

- e. Schedules.
- f. Resolution of Conflicts.
- 3. Technical Documents Interpretation:
 - a. Consult with Architect to obtain interpretation.
 - b. Assist in resolution of questions or conflicts which may arise.
 - c. Transmit written interpretations to Subcontractors and to other concerned parties.
- 4. Permits & Approvals:
 - a. Verify that Subcontractors have obtained required Permits and Inspections for Work and for Temporary Facilities.
- 5. Control use of Site:
 - a. Supervise Field Engineering and Project Layout.
 - b. Allocate Field Office Space and Work and Storage Areas for use of each Subcontractor.

1.05 COORDINATING SUBCONTRACTORS' WORK

- A. Coordinate the Work of all Subcontractors and make certain that, where the Work of one Trade is dependent upon the Work of another Trade, the Work first installed is properly placed, installed, aligned, and finished as specified or required to properly receive subsequent Materials applied or attached thereto.
- B. Direct Subcontractors to correct defects in Substrates they install when Subcontractors of subsequent Materials have a reasonable and justifiable objection to such surfaces.
- C. Do not force Subcontractors to apply or install Products to improperly placed or improperly finished Substrates that would result in an unsatisfactory or unacceptable finished Product.

1.06 COORDINATING WORK WITH WORK OF OWNER OR OTHER CONTRACTS

- A. Coordinate, and make certain that, where Work of either party is dependent upon the other party, the Work first performed is properly placed, installed, aligned, and finished as required to permit the proper installation of the Work following.
- B. If the Owner's Work in any way interferes with the Contractor's Work, so notify the Owner sufficiently in advance so that the Owner has reasonable time to make necessary adjustments.
- C. If the Contractor's Work in any way interferes with Owner's Work, so notify the Owner as soon as possible. If the Contractor's Work must be modified to accommodate the Owner's Work, except as described elsewhere in this Specification, the Contract Sum and/or the Contract Time will, when necessary be adjusted by a Change Order.

1.07 CLOSE-OUT DUTIES

- A. Mechanical & Electrical Equipment start-up:
 - 1. Coordinate check-out of Utilities, Operational Systems, and Equipment.
 - 2. Coordinate site visits of the Owner's Commissioning Agent.
 - 3. Assist in initial start-up and testing.
 - 4. Record starting dates of Systems and Equipment operation.
- B. At completion of Work of each Subcontract, conduct inspection to assure that:
 - 1. Work is acceptable.
 - 2. Specified cleaning has been accomplished, and Temporary Facilities and Debris has been removed from Site.
- C. Substantial Completion:
 - 1. Conduct inspection and prepare list of Work to be completed or corrected.
 - 2. Assist Architect in review of contractor's inspection list and generation of substantial completion punch list.
 - 3. Supervise correction and completion of Work as established in Architect's Observation Reports and substantial completion punch list.
 - 4. Apply for and receive Final Occupancy Permit from Building Department.
 - 5. Complete submittal of Operations and Maintenance Manuals.

- 6. Complete submittal of Record Drawings.
- 7. Complete Owner Training.
- D. Final Completion:
 - 1. Assist Architect in checking that all identified deficiencies have been corrected.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

- A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, MS Excel, or AutoCAD .dwg or Revit .rvt) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
 - 1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Information (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
 - 2. Contractor and Architect are required to use this service.
 - 3. It is Contractor's responsibility to submit documents in allowable format.
 - 4. Subcontractors, suppliers, and Architect's consultants are to be permitted to use the service at no extra charge.
 - 5. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
 - 6. Except with prior approval of the architect, paper document transmittals will not be reviewed; emailed electronic documents will not be reviewed.
 - 7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.
- B. Cost: The cost of the service is to be paid by Contractor; include the cost of the service in the Contract Sum.
- C. Submittal Service: The selected service is:1. To be mutually agreed to by Owner, Architect and Contractor.
- D. Training: One, one-hour, web-based training session will be arranged for all participants, with representatives of Architect and Contractor participating; further training is the responsibility of the user of the service.
 - 1. Representatives of Owner are scheduled and included in this training.
- E. Project Closeout: Contractor is responsible for obtaining archive copies of all of the electronic documents and submitting them to the Owner and Architect as part of the Operations and Maintenance documents.

3.02 PRECONSTRUCTION MEETING

- A. Owner will schedule a meeting after Notice of Award.
- B. Attendance Required:
 - 1. Owner.
 - 2. Architect.
 - 3. Contractor.
 - 4. Contractor's Superintendent.
 - 5. Major Subcontractors .
 - 6. Others as needed.

C. Agenda:

- 1. Introductions.
- 2. Execution of Owner-Contractor Agreement.
- 3. Submission of executed bonds and insurance certificates.
- 4. Description of Project
- 5. Distribution of Contract Documents.
- 6. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
- 7. Submission of initial Submittal schedule.
- 8. Designation of personnel representing the parties to Contract, Owner and Architect.
- 9. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 - a. Written Change Order requests required
 - b. Supporting documentation will be required for all Change Order proposals
 - c. Describe Contractor's procedure for review and oversight in the preparation of Change Orders
 - d. Mark-up limitations on Change Orders (See General Conditions Article 7.1.4)
 - e. Processing time required
 - f. Applications for Payment
 - 1) Use AIA documents G702 and G703 latest edition
 - 2) Wage certifications to be attached or submitted directly to Owner
- 10. Scheduling, start date and date of substantial completion.
- 11. Scheduling activities of a Geotechnical Engineer.
- 12. Building permit status.
- 13. Prevailing wage requirements.
- 14. Public Agency submittal of Responsible Bidder Determination Form to Construction Contractor's Board (ORS 279C.375).
- 15. Communications.
- 16. Role of Owner's Project Manager.
- 17. Submittals required per Contract Documents.
- 18. MSDS Information
- 19. Erosion control procedures
- 20. Waste management procedures
- 21. Environmental quality requirements
- 22. Hazardous materials
- 23. Construction activities, working hours, use of site and building.
- 24. Staging and parking areas.
- 25. Temporary facilities and utilities.
- 26. Request for information and clarification of design
- 27. Correction of Defects.
- 28. Weekly on-site progress meetings.
- 29. Safety and Emergency Procedures.
- 30. Verify that Contractor's Mandatory Drug Testing Program is in place.
- 31. Daily Clean-up
- 32. Project Closeout, substantial completion, final completion.
- 33. Record Drawings and Operations and Maintenance Manuals
- 34. Additional Comments
- D. Record minutes and distribute copies withinthree days after meeting to participants, with digital copies to Architect, Owner, other participants, and those affected by decisions made.

3.03 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the work at maximum bi-monthly intervals.

- B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- C. Attendance Required:
 - 1. Contractor.
 - 2. Owner.
 - 3. Architect.
 - 4. Contractor's superintendent.
 - 5. Major subcontractors.
 - 6. Design team consultants as needed.
- D. Agenda:
 - 1. Review minutes of previous meetings.
 - 2. Review of work progress.
 - 3. Field observations, problems, and decisions.
 - 4. Identification of problems that impede, or will impede, planned progress.
 - 5. Review of submittals schedule and status of submittals.
 - 6. Review of RFIs log and status of responses.
 - 7. Review of off-site fabrication and delivery schedules.
 - 8. Maintenance of progress schedule.
 - 9. Corrective measures to regain projected schedules.
 - 10. Planned progress during succeeding work period.
 - 11. Coordination of projected progress.
 - 12. Maintenance of quality and work standards.
 - 13. Effect of proposed changes on progress schedule and coordination.
 - 14. Other business relating to the work.
- E. Record minutes and distribute copies within five days after meeting to participants, with digital copies to Architect, Owner, other participants, and those affected by decisions made.

3.04 PRE-INSTALLATION CONFERENCES

- A. When required in individual specification sections, the Contractor shall convene a pre-installation meeting prior to commencing work of that section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Architect minimum four days in advance of meeting date.
- D. The Contractor shall be responsible to prepare agenda and preside at meeting:
 - 1. Review conditions of installation, preparation and installation procedures.
 - 2. Review coordination with related work.
- E. The Contractor shall be responsible to record minutes and distribute copies within four days after meeting to participants, with copies to Architect, Owner's Project Manager, participants, and those affected by decisions made.

3.05 CONSTRUCTION PROGRESS SCHEDULE - SEE SECTION 01 3216

3.06 COORDINATION DRAWINGS

- A. Provide coordination drawings along the main runs of HVAC and Electrical systems including:
 - 1. HVAC Equipment including access clearances
 - 2. Ductwork
 - 3. Conduit
 - 4. Cable Tray
 - 5. Recessed and Suspended Light Fixtures
 - 6. Fire Sprinkler Piping
 - 7. Suspension and support systems for the above.
 - 8. Ceiling systems
 - 9. Any additional ceiling mounted equipment including operational and maintenance clearances.

- B. Areas of the building to be modeled include the following:
 - 1. Central Circulation Corridors and Hallways
 - 2. Mechanical, electrical and communication rooms
- C. Prepare coordination drawings using Autodesk AutoCAD or Revit software, current version. Architect will provide base drawings in AutoCAD format or allow access to the Revit Model that the Architect used in preparing the construction documents. Refer to the General Conditions for limitations on the use and accuracy of this information.
- D. Make necessary revisions during the construction work and include a final copy as a record drawing submission during the project closeout process.

3.07 REQUESTS FOR INFORMATION (RFI)

- A. Definition: A request seeking one of the following:
 - 1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
 - 2. A resolution to an issue which has arisen due to field conditions and affects design intent.
- B. Whenever possible, request clarifications at the next appropriate project progress meeting, with response entered into meeting minutes, rendering unnecessary the issuance of a formal RFI.
- C. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
 - 1. Prepare a separate RFI for each specific item.
 - a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
 - b. Do not forward requests which solely require internal coordination between subcontractors.
 - 2. Prepare in a format and with content acceptable to Owner.
 - 3. Prepare using software provided by the Electronic Document Submittal Service.
 - 4. Combine RFI and its attachments into a single PDF Format electronic file.
- D. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
 - 1. Include in each request Contractor's signature attesting to good faith effort to determine from Contract Documents information requiring interpretation.
 - 2. Unacceptable Uses for RFIs: Do not use RFIs to request the following::
 - a. Approval of submittals (use procedures specified elsewhere in this section).
 - b. Approval of substitutions (see Section 01 6000 Product Requirements)
 - c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
 - d. Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).
 - 3. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response, with an explanatory notation.
 - 4. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, Contract Documents, with no additional input required to clarify the question. They will be returned without a response, with an explanatory notation.
- E. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
 - 1. Official Project name and number, and any additional required identifiers established in Contract Documents.
 - 2. Owner's, Architect's, and Contractor's names.

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- 3. Discrete and consecutive RFI number, and descriptive subject/title.
- 4. Issue date, and requested reply date.
- 5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
- 6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
- 7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.
- F. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.
- G. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
 - 1. Indicate current status of every RFI. Update log promptly and on a regular basis.
 - 2. Note dates of when each request is made, and when a response is received.
 - 3. Highlight items requiring priority or expedited response.
 - 4. Highlight items for which a timely response has not been received to date.
 - 5. Identify and include improper or frivolous RFIs.
- H. Review Time: Architect will respond and return RFIs to Contractor within seven calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.
 - 1. Response period may be shortened or lengthened for specific items, subject to mutual agreement, and recorded in a timely manner in progress meeting minutes.
- I. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.
 - 1. Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issued forthwith. Identify the amended RFI with an R suffix to the original number.
 - 2. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.
 - 3. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.
 - 4. Notify Architect within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

3.08 SUBMITTAL SCHEDULE

- A. Submit to Architect for review a schedule for submittals in tabular format.
 - 1. Submit at the same time as the preliminary schedule specified in Section 01 3216 Construction Progress Schedule.
 - 2. Coordinate with Contractor's construction schedule and schedule of values.
 - 3. Format schedule to allow tracking of status of submittals throughout duration of construction.
 - 4. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.
 - 5. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.

a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.

3.09 SUBMITTALS FOR REVIEW

- A. When the following are specified in individual sections, submit them for review:
 - 1. Product data.
 - 2. Shop drawings.
 - 3. Samples for selection.
 - 4. Samples for verification.
 - 5. Other information required in individual specification sections.
- B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.
- C. Product Data:
 - 1. Clearly mark each copy to identify pertinent Products.
 - 2. Show performance characteristics and capacities.
 - 3. Show dimensions, field dimensions, and required clearances.
 - 4. Show wiring and piping diagrams, and controls.
 - 5. Show standard schematic drawings and diagrams:
 - a. Modify to delete information not applicable to Work.
 - b. Supplement standard information to provide information specifically applicable to Work.
 - c. Assure that any photo copied material is clearly legible or provide all original material.
- D. Samples will be reviewed for aesthetic, color, or finish selection.
- E. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 7800 Closeout Submittals.

3.10 SUBMITTALS FOR INFORMATION

- A. When the following are specified in individual sections, submit them for information:
 - 1. Design data.
 - 2. Certificates.
 - 3. Test reports.
 - 4. Inspection reports.
 - 5. Manufacturer's instructions.
 - 6. Manufacturer's field reports.
 - 7. Other information required in individual specification sections.
 - 8. Other types indicated.
- B. Submit for Architect's knowledge as contract administrator or for Owner.

3.11 SUBMITTALS FOR PROJECT CLOSEOUT

- A. Submit Correction Punch List for Substantial Completion.
- B. Submit Final Correction Punch List for Substantial Completion.
- C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 7800 Closeout Submittals:
 - 1. Project record documents.
 - 2. Operation and maintenance data.
 - 3. Warranties.
 - 4. Bonds.
 - 5. Other information required in individual specification sections.
 - 6. Other types as indicated.
- D. Submit for Owner's benefit during and after project completion.

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3.12 NUMBER OF COPIES OF SUBMITTALS

- A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.
- B. Samples: Submit the number specified in individual specification sections; two of which will be retained by Architect.
 - 1. After review, produce duplicates.
 - 2. Retained samples will not be returned to Contractor unless specifically so stated.
 - 3. Show full range of color, texture & pattern.

3.13 SUBMITTAL PROCEDURES

- A. General Requirements:
 - 1. Use a single transmittal for related items.
 - 2. Submit separate packages of submittals for review and submittals for information, when included in the same specification section.
 - 3. Transmit using approved form.
 - a. Use Contractor's form, subject to prior approval by Architect.
 - 4. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
 - 5. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
 - 6. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
 - a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
 - 7. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
 - a. Send submittals in electronic format via email to Architect.
 - b. Unless otherwise approved by the Architect in advance of receipt of the submittal, all information and any markup of PDF documents shall be produced using appropriate PDF editing software, and not handwritten. PDF documents shall not be scanned original copies, but shall be submitted in their original digital form and remain fully searchable using PDF viewing software in common use.
 - 8. Schedule submittals to expedite the Project, and coordinate submission of related items.
 - a. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
 - b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 7 days.
 - 9. Notify Architect in writing, at submission time, of any deviations in Submittals from Contract Document requirements. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
 - 10. Provide space for Contractor and Architect review stamps.
 - 11. When revised for resubmission, identify all changes made since previous submission.
 - 12. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
 - 13. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
 - 14. Submittals not requested will be recognized, and will be returned "Not Reviewed",
- B. Product Data Procedures:
 - 1. Submit only information required by individual specification sections.
 - 2. Collect required information into a single submittal.

- 3. Submit concurrently with related shop drawing submittal.
- 4. Do not submit (Material) Safety Data Sheets for materials or products. Maintain a copy of the MSDS sheets on site.
- C. Shop Drawing Procedures:
 - 1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
 - 2. Do not reproduce Contract Documents to create shop drawings.
 - 3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.
- D. Samples Procedures:
 - 1. Transmit related items together as single package.
 - 2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.
- E. Perform no Work or Fabrication requiring Submittal until Architect approves Submittal.

3.14 SUBMITTAL REVIEW

- A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.
- B. Submittals for Information: Architect will acknowledge receipt and review. See below for actions to be taken.
- C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
 - 1. Notations may be made directly on submitted items and/or listed on appended Submittal Review cover sheet.
- D. Architect's and consultants' actions on items submitted for review:
 - 1. Authorizing purchasing, fabrication, delivery, and installation:
 - a. "No Exception Taken", or language with same legal meaning.
 - b. "Make Corrections Noted", or language with same legal meaning.
 - 1) Incorporate review comments. Contractor is not required to resubmit.
 - 2) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated, for Architect's records.
 - 2. Not Authorizing fabrication, delivery, and installation:
 - a. "Revise and Resubmit".
 - 1) Resubmit revised item, with review notations acknowledged and incorporated.
 - 2) Non-responsive resubmittals may be rejected.
 - b. "Rejected".
 - 1) Submit item complying with requirements of Contract Documents.
- E. Architect's and consultants' actions on items submitted for information:
 - 1. Items for which no action was taken:
 - a. "Received" to notify the Contractor that the submittal has been received for record only.
 - 2. Items for which action was taken:
 - a. "Reviewed" no further action is required from Contractor.

SECTION 01 3216 CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preliminary schedule.
- B. Construction progress schedule, bar chart type.
- C. Construction progress schedule, three week look ahead.

1.02 SUBMITTALS

- A. Within 10 days after date of Agreement, submit preliminary schedule defining planned operations for the first 60 days of Work, with a general outline for remainder of Work.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. Submit updated schedule with each Application for Payment.
- D. Submit in PDF format.

1.03 SCHEDULE FORMAT

- A. Listings: In chronological order according to the start date for each activity. Identify each activity with the applicable specification section number.
- B. Sheet Size: 11 x 17 inches or 22 x 34 inches.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRELIMINARY SCHEDULE

A. Prepare preliminary schedule in the form of a horizontal bar chart.

3.02 CONTENT

- A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- B. Identify each item by specification section number.
- C. Identify work of separate stages and other logically grouped activities.
- D. Provide sub-schedules to define critical portions of the entire schedule.
- E. Include conferences and meetings in schedule.
- F. Provide separate schedule of submittal dates for shop drawings, product data, and samples, owner-furnished products, and dates reviewed submittals will be required from Architect. Indicate decision dates for selection of finishes.
- G. Indicate delivery dates for owner-furnished products.
- H. Coordinate content with schedule of values specified in Section 01 2000 Price and Payment Procedures.
- I. Provide legend for symbols and abbreviations used.

3.03 BAR CHARTS

- A. Include a separate bar for each major portion of Work or operation.
- B. Identify the first work day of each week.
- C. Illustrate order and interdependence of activities and sequence of work; how start of a given activity depends on completion of preceding activities, and how completion of the activity may restrain start of subsequent activities.

3.04 THREE WEEK LOOK AHEAD SCHEDULE

- A. Each week during construction, provide companion schedule to master project schedule to look ahead three weeks. Provide increased detail as requested by the Owner or Architect to clearly show the work planned for the upcoming weeks.
- B. Distribute at the beginning of each weekly project meeting.

3.05 REVIEW AND EVALUATION OF SCHEDULE

- A. Participate in joint review and evaluation of schedule with Architect at each submittal.
- B. Evaluate project status to determine work behind schedule and work ahead of schedule.
- C. After review, revise as necessary as result of review, and resubmit within 10 days.

3.06 UPDATING SCHEDULE

- A. Maintain schedules to record actual start and finish dates of completed activities.
- B. Indicate progress of each activity to date of revision, with projected completion date of each activity.
- C. Annotate diagrams to graphically depict current status of Work.
- D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.
- E. Indicate changes required to maintain Date of Substantial Completion.
- F. Submit reports required to support recommended changes.
- G. Provide narrative report to define problem areas, anticipated delays, and impact on the schedule. Report corrective action taken or proposed and its effect.

3.07 DISTRIBUTION OF SCHEDULE

- A. Distribute copies of updated schedules to Contractor's project site file, to subcontractors, suppliers, Architect, Owner, and other concerned parties.
- B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

SECTION 01 4000 QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Quality Assurance Submittals.
- B. References and standards.
- C. Testing and inspection agencies and services.
- D. Control of installation.
- E. Mock-ups.
- F. Tolerances.
- G. Manufacturers' field services.
- H. Defect Assessment.

1.02 RELATED REQUIREMENTS

- A. Section 01 3000 Administrative Requirements: Submittal procedures.
- B. Section 01 6000 Product Requirements: Requirements for material and product quality.

1.03 REFERENCE STANDARDS

- A. ASTM C1021 Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2019).
- B. ASTM C1077 Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation; 2017.
- C. ASTM C1093 Standard Practice for Accreditation of Testing Agencies for Masonry; 2022.
- D. ASTM D3740 Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2019.
- E. ASTM E329 Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2021.
- F. ASTM E543 Standard Specification for Agencies Performing Nondestructive Testing; 2021.
- G. OSSC Oregon Structural Specialty Code, latest edition.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
 - 1. Include calculations that have been used to demonstrate compliance to performance and regulatory criteria provided, and to determine design solutions.
 - 2. Include required product data and shop drawings.
 - 3. Include a statement or certification attesting that design data complies with criteria indicated, such as building codes, loads, functional, and similar engineering requirements.
 - 4. Include signature and seal of design professional responsible for allocated design services on calculations and drawings.
- C. Test Reports: After each test/inspection, promptly submit one digital copy of report to Owner, Architect, Engineer, Authority Having Jurisdiction, and to Contractor.
 - 1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of inspector.
 - d. Date and time of sampling or inspection.

- e. Identification of product and specifications section.
- f. Location in the Project.
- g. Type of test/inspection.
- h. Date of test/inspection.
- i. Results of test/inspection.
- j. Compliance with Contract Documents.
- k. When requested by Architect, provide interpretation of results.
- 2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's and other interested party information.
- 3. Copies of Test Reports should also be provided directly to the Owner, Design Engineer, and the City of Eugene Building Department.
- D. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
 - 1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
 - 2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.
- E. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- F. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
 - 1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.
- G. Erection Drawings: Submit drawings for Architect's benefit as contract administrator or for Owner.
 - 1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.
 - 2. Data indicating inappropriate or unacceptable Work may be subject to action by Architect or Owner.

1.05 REFERENCES AND STANDARDS

- A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Comply with reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.
- C. Obtain copies of standards where required by product specification sections.
- D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.
- E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.
- F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from Contract Documents by mention or inference otherwise in any reference document.

1.06 TESTING AND INSPECTION AGENCIES AND SERVICES

- A. Owner will employ and pay for services of an independent testing agency to perform specified testing.
- B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

1.07 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 the Owner, described as follows:
 - 1. Structural fills and compaction
 - 2. Reinforcing of structural concrete
 - 3. Anchor bolt placement
 - 4. Concrete strength
 - 5. Structural concrete placement
 - 6. Adhesive anchors installed in concrete (Epoxy anchors)
 - 7. Expansion anchors
 - 8. Structural welding
 - 9. High strength bolting
 - 10. Structural steel
 - 11. Other structural testing and inspections listed in the structural specifications and drawings.
 - 12. Asphalt concrete pavement
 - 13. Domestic water system disinfection
 - 14. Other testing as required by regulatory agencies or as indicated in the drawings or specifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 MOCK-UPS

- A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.
- B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.
- C. Integrated Exterior Mock-ups: Construct integrated exterior mock-up as indicated on drawings. Coordinate installation of exterior envelope materials and products as required in individual

Specification Sections. Provide adequate supporting structure for mock-up materials as necessary.

- 1. Construct mock-up as indicated on drawings.
- 2. Mock-up may remain as part of the Work.
- D. Notify Architect fifteen (15) working days in advance of dates and times when mockups will be constructed.
- E. Provide supervisory personnel who will oversee mock-up construction. Provide workers that will be employed during the construction of the Project.
- F. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.
- G. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- H. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.
 1. Make corrections as necessary until Architect's approval is issued.
- I. Architect will use accepted mock-ups as a comparison standard for the remaining Work.
- J. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.
- K. Where possible salvage and recycle the demolished mock-up materials.

3.03 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

3.04 TESTING AND INSPECTION

- A. See individual specification sections and the current building code for testing and inspection required.
- B. Comply with OSSC Requirements for products and systems used in project.
- C. Testing Agency Duties:
 - 1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
 - 2. Perform specified sampling and testing of products in accordance with specified standards.
 - 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 - 4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
 - 5. Perform additional tests and inspections required by Architect.
 - 6. Submit reports of all tests/inspections specified.
- D. Limits on Testing/Inspection Agency Authority:
 - 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 - 2. Agency may not approve or accept any portion of the Work.
 - 3. Agency may not assume any duties of Contractor.
 - 4. Agency has no authority to stop the Work.
- E. Contractor Responsibilities:
 - 1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
- 2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
- 3. Provide incidental labor and facilities:
 - a. To provide access to Work to be tested/inspected.
 - b. To obtain and handle samples at the site or at source of Products to be
 - tested/inspected.
 - c. To facilitate tests/inspections.
 - d. To provide storage and curing of test samples.
- 4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
- 5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- 6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- F. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.
- G. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor. Payment for re testing will be charged to the Contractor by deducting testing charges from the Contract Price.

3.05 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Architect 30 days in advance of required observations.
 1. Observer subject to approval of Architect.
 - Observer subject to approval of Atennet
 Observer subject to approval of Owner.
- C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.06 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not complying with specified requirements.

SECTION 01 5000 TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Dewatering
- B. Temporary sanitary facilities.
- C. Temporary Controls: Barriers, enclosures, and fencing.
- D. Security requirements.
- E. Vehicular access and parking.
- F. Waste removal facilities and services.
- G. Project identification sign.
- H. Field offices.

1.02 RELATED REQUIREMENTS

A. Section 01 5100 - Temporary Utilities.

1.03 SUBMITTALS

A. Contractor shall prepare and submit a logistics plan describing how temporary facilities and control will be addressed, obtaining approval from the Owner prior to commencing the Work.

1.04 DEWATERING

A. Provide temporary means and methods for dewatering all temporary facilities and controls.

1.05 TELECOMMUNICATIONS SERVICES

- A. Contractor shall arrange for, maintain, and pay for telecommunications services to field office at time of project mobilization.
- B. Telecommunications services shall include:
 - 1. Windows-based personal computer dedicated to project telecommunications, with necessary software and laser printer.
 - 2. Internet Connections: Minimum of one; DSL modem or faster, with WIFI service.
 - a. Allow Owner, Architect, Consultants and other members of the project team WIFI Access to the Internet through this connection.

1.06 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
- B. Maintain daily in clean and sanitary condition.

1.07 BARRIERS

- A. Provide barriers to protect workers on the site and the public against injury.
- B. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage as a result of construction operations and demolition.
- C. Provide barricades and covered walkways required by governing authorities for public rights-of-way.
- D. Provide protection for plants designated to remain. Replace damaged plants.
- E. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.
- F. Traffic Controls: Provide as required to maintain safe working environment for Owner and Contractor personnel using the site.

1.08 TEMPORARY FIRE PROTECTION

A. Provide and maintain necessary facilities and equipment to safeguard Project against Fire Damage.

1.09 FENCING

A. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.10 EXTERIOR ENCLOSURES

A. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.11 SECURITY

- A. Provide security and facilities to protect Work, and Owner's operations from unauthorized entry, vandalism, or theft.
- B. Coordinate with Owner's security program.

1.12 VEHICULAR ACCESS AND PARKING

- A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.
- B. Coordinate access and haul routes with governing authorities and Owner.
- C. Provide and maintain access to fire hydrants, free of obstructions.
- D. Provide means of removing mud from vehicle wheels before entering streets.
- E. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.
- F. Do not use Owner's Parking Lots for overnight vehicle storage.
- G. Repair and restore existing facilities damaged by use, to original condition.
- H. Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes. Comply with state transportation and local public works and other related agency requirements.

1.13 MATERIAL STORAGE SPACE

A. Maintain within Project Limits in accordance with Architect's and Owner's instructions. Do not block exitways or overload structure.

1.14 WASTE REMOVAL

- A. See Section 01 7419 Construction Waste Management and Disposal, for additional requirements.
- B. Encourage the separation of waste materials and sorting and disposal at a local recycling center. Comply with local construction waste disposal rules and regulations.
- C. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- D. Provide containers with lids. Remove trash from site on a regular basis or when directed to by Owner.
- E. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
- F. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.15 PROJECT IDENTIFICATION

A. Provide project identification sign of design, construction, and location approved by Owner.

1.16 FIELD OFFICES

- A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture and storage space for drawings and all project documents.
- B. Provide space for Project meetings, with table and chairs to accommodate 8 persons.
- C. Provide office within 15 days from Notice to Proceed, maintain, and remove prior to Substantial Completion or as agreed by Owner.

1.17 VISITOR PERSONAL PROTECTION EQUIPMENT

- A. Provide six sets of Personal Protection Equipment (PPE) for use by official visitors to the project site during construction. Visitor PPE shall include as a minimum, hard hat and OSHA approved protective safety glasses. Provide high visibility garments when moving vehicles are in use on the construction site. Store in Field Office and reserve for use by visitors to the project site.
- B. Maintain in good condition through the course of the project and replace equipment that does not meet personal safety requirements.

1.18 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.
- B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.
- D. Restore existing facilities used during construction to original condition.
- E. Restore new permanent facilities used during construction to specified condition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

SECTION 01 5100 TEMPORARY UTILITIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Temporary Utilities: Provision of electricity, lighting, heat, ventilation, and water.

1.02 RELATED REQUIREMENTS

- A. Section 01 5000 Temporary Facilities and Controls:
 - 1. Temporary telecommunications services for administrative purposes.
 - 2. Temporary sanitary facilities required by law.

1.03 REFERENCE STANDARDS

A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.

1.04 TEMPORARY ELECTRICITY

- A. Cost: By Contractor.
- B. Provide power service required from utility source.
- C. Provide power outlets for construction operations, with branch wiring and distribution boxes located at each floor. Provide flexible power cords as required.
- D. Provide main service disconnect and over-current protection at convenient location and meter.
- E. Permanent convenience receptacles may be utilized during construction.
- F. Provide adequate distribution equipment, wiring, and outlets to provide single phase branch circuits for power and lighting.

1.05 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

- A. Provide and maintain LED, compact fluorescent, or high-intensity discharge lighting as suitable for the application for construction operations in accordance with requirements of 29 CFR 1926 and authorities having jurisdiction.
- B. Provide and maintain 1 watt/sq ft lighting to exterior staging and storage areas after dark for security purposes.
- C. Provide and maintain 0.25 watt/sq ft H.I.D. lighting to interior work areas after dark for security purposes.
- D. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.
- E. Maintain lighting and provide routine repairs.
- F. Permanent building lighting may be utilized during construction.

1.06 TEMPORARY HEATING

- A. Cost of Energy: By Contractor.
- B. Provide heating devices and heat as needed to maintain specified conditions for construction operations.
- C. Maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.

1.07 TEMPORARY COOLING

- A. Cost of Energy: By Contractor.
- B. Provide cooling devices and cooling as needed to maintain specified conditions for construction operations.
- C. Maintain maximum ambient temperature of 80 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.

1.08 TEMPORARY VENTILATION

A. Utilize existing ventilation equipment. Extend and supplement equipment with temporary fan units as required to maintain clean air for construction operations.

1.09 TEMPORARY WATER SERVICE

- A. Cost of Water Used: By Contractor.
- B. Provide and maintain suitable quality water service for construction operations at time of project mobilization.
- C. Connect to existing water source.1. Exercise measures to conserve water.
- D. Extend branch piping with outlets located so water is available by hoses with threaded connections. Provide temporary pipe insulation to prevent freezing.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

SECTION 01 57 13 TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Prevention of erosion due to construction activities.
- B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.
- C. Restoration of areas eroded due to insufficient preventive measures.
- D. Compensation of Owner for fines levied by authorities having jurisdiction due to non-compliance by Contractor.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 Cast-in-Place Concrete: Concrete for temporary and permanent erosion control structures indicated on drawings.
- B. Section 31 10 00 Site Clearing: Limits on clearing; disposition of vegetative clearing debris.
- C. Section 31 22 00 Grading: Temporary and permanent grade changes for erosion control.
- D. Section 32 11 23 Aggregate Base Courses: Temporary and permanent roadways.

1.03 PERFORMANCE REQUIREMENTS

- A. Comply with requirements of EPA (NPDES) for erosion and sedimentation control, as specified by the NPDES, for Phases I and II, and in compliance with requirements of Construction General Permit (CGP), whether the project is required by law to comply or not.
- B. Also comply with all more stringent requirements of State of Oregon DEQ Erosion and Sedimentation Control Manual.
- C. Also complet with all more stringent requirements of Rogue Valley Sewer Services (permitting and inspection authority on behalf of Oregon DEQ) Erosion Prevention and Sediment Control Requirements.
- D. Best Management Practices Standard: FHWA FLP-94-005.
- E. Develop and follow an Erosion and Sedimentation Prevention Plan and submit periodic inspection reports.
- F. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.
 - 1. Owner will obtain permits and pay for securities required by authority having jurisdiction.
 - 2. Owner will withhold payment to Contractor equivalent to all fines resulting from non-compliance with applicable regulations.
- G. Timing: Put preventive measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.
- H. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.
 - 1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.
 - 2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 2 years.
- I. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
 - 1. Control movement of sediment and soil from temporary stockpiles of soil.
 - 2. Prevent development of ruts due to equipment and vehicular traffic.
 - 3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner

- J. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.
 - 1. Prevent windblown soil from leaving the project site.
 - 2. Prevent tracking of mud onto public roads outside site.
 - 3. Prevent mud and sediment from flowing onto sidewalks and pavements.
 - 4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.
- K. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
 - 1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
 - 2. If sediment basins are used as temporary preventive measures, pump dry and remove deposited sediment after each storm.
- L. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
 - 1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
- M. Open Water: Prevent standing water that could become stagnant.
- N. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

1.04 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
- B. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements, signed by legally authorized official of manufacturer; indicate actual minimum average roll values; identify fabric by roll identification numbers.
- C. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.
- D. Maintenance Instructions: Provide instructions covering inspection and maintenance for temporary measures that must remain after Substantial Completion.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Mulch: Use one of the following:
 - 1. Wood waste, chips, or bark.
 - 2. Erosion control matting or netting.
 - 3. Polyethylene film, where specifically indicated only.
- B. Grass Seed For Temporary Cover: Select a species appropriate to climate, planting season, and intended purpose. If same area will later be planted with permanent vegetation, do not use species known to be excessively competitive or prone to volunteer in subsequent seasons.
- C. Silt Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams with the following minimum average roll lengths:
 - 1. Average Opening Size: 30 U.S. Std. Sieve, maximum, when tested in accordance with ASTM D4751.
 - 2. Permittivity: 0.05 sec^-1, minimum, when tested in accordance with ASTM D4491/D4491M.
 - 3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D4355/D4355M after 500 hours exposure.
 - 4. Tensile Strength: 100 pounds-force, minimum, in cross-machine direction; 124 pounds-force, minimum, in machine direction; when tested in accordance with ASTM D4632/D4632M.

- 5. Elongation: 15 to 30 percent, when tested in accordance with ASTM D4632/D4632M.
- 6. Tear Strength: 55 pounds-force, minimum, when tested in accordance with ASTM D4533.
- 7. Color: Manufacturer's standard, with embedment and fastener lines preprinted.
- 8. Manufacturers:
 - a. BP Amoco, Amoco Fabrics and Fibers: www.geotextile.com
 - b. TenCate: www.tencate.com
 - c. North American Green: www.nagreen.com
 - d. Propex Geosynthetics: www.geotextile.com
- D. Silt Fence Posts: One of the following, minimum 5 feet long:
 - 1. Hardwood, 2 by 2 inches in cross section.
- E. Gravel: See Section 32 11 23 for aggregate.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.02 PREPARATION

A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.03 SCOPE OF PREVENTIVE MEASURES

- A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.
- B. Construction Entrances: Traffic-bearing aggregate surface.
 - 1. Width: As required; 30 feet, minimum.
 - 2. Length: 50 feet, minimum.
 - 3. Provide at each construction entrance from public right-of-way.
 - 4. Where necessary to prevent tracking of mud onto right-of-way, provide wheel washing area out of direct traffic lane, with drain into sediment trap or basin.
- C. Linear Sediment Barriers: Made of silt fences.
 - 1. Provide linear sediment barriers:
 - a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.
 - b. Along the top of the slope or top bank of drainage channels and swales that traverse disturbed areas.
 - c. Along the toe of cut slopes and fill slopes.
 - d. Perpendicular to flow across the bottom of existing and new drainage channels and swales that traverse disturbed areas or carry runoff from disturbed areas; space at maximum of 200 feet apart.
 - e. Across the entrances to culverts that receive runoff from disturbed areas.
 - 2. Space sediment barriers with the following maximum slope length upslope from barrier:
 - a. Slope of Less Than 2 Percent: 100 feet..
 - b. Slope Between 2 and 5 Percent: 75 feet.
 - c. Slope Between 5 and 10 Percent: 50 feet.
 - d. Slope Between 10 and 20 Percent: 25 feet.
 - e. Slope Over 20 Percent: 15 feet.
- D. Storm Drain Curb Inlet Sediment Trap: Protect each curb inlet using one of the following measures:
 - 1. Filter fabric wrapped around hollow concrete blocks blocking entire inlet face area; use one piece of fabric wrapped at least 1-1/2 times around concrete blocks and secured to prevent dislodging; orient cores of blocks so runoff passes into inlet.
 - 2. Straw bale row blocking entire inlet face area; anchor into pavement.
- E. Storm Drain Drop Inlet Sediment Traps: As detailed on drawings.

- F. Temporary Splash Pads: Stone aggregate over filter fabric; size to suit application; provide at downspout outlets and storm water outlets.
- G. Soil Stockpiles: Protect using one of the following measures:
 - 1. Cover with polyethylene film, secured by placing soil on outer edges.
 - 2. Cover with mulch at least 4 inches thickness of pine needles, sawdust, bark, wood chips, or shredded leaves, or 6 inches of straw or hay.
- H. Mulching: Use only for areas that may be subjected to erosion for less than 6 months.
 - 1. Wood Waste: Use only on slopes 3:1 or flatter; no anchoring required.
 - Temporary Seeding: Use where temporary vegetated cover is required.

3.04 INSTALLATION

Ι.

- A. Traffic-Bearing Aggregate Surface:
 - 1. Excavate minimum of 6 inches.
 - 2. Place geotextile fabric full width and length, with minimum 24 inch overlap at joints.
 - 3. Place and compact at least 8 inches of 2 inch diameter drain rock.
- B. Silt Fences:
 - 1. Store and handle fabric in accordance with ASTM D4873.
 - 2. Where slope gradient is less than 3:1 or barriers will be in place less than 6 months, use nominal 16 inch high barriers with minimum 36 inch long posts spaced at 6 feet maximum, with fabric embedded at least 4 inches in ground.
 - 3. Where slope gradient is steeper than 3:1 or barriers will be in place over 6 months, use nominal 28 inch high barriers, minimum 48 inch long posts spaced at 6 feet maximum, with fabric embedded at least 6 inches in ground.
 - 4. Where slope gradient is steeper than 3:1 and vertical height of slope between barriers is more than 20 feet, use nominal 32 inch high barriers with woven wire reinforcement and steel posts spaced at 4 feet maximum, with fabric embedded at least 6 inches in ground.
 - 5. Install with top of fabric at nominal height and embedment as specified.
 - 6. Do not splice fabric width; minimize splices in fabric length; splice at post only, overlapping at least 18 inches, with extra post.
 - 7. Fasten fabric to wood posts using one of the following:
 - a. Four nails per post with 3/4 inch diameter flat or button head, 1 inch long, and 14 gauge, 0.083 inch shank diameter.
 - b. Five staples per post with at least 17 gauge, 0.0453 inch wire, 3/4 inch crown width and 1/2 inch long legs.
 - 8. Wherever runoff will flow around end of barrier or over the top, provide temporary splash pad or other outlet protection; at such outlets in the run of the barrier, make barrier not more than 12 inches high with post spacing not more than 4 feet.
- C. Temporary Seeding:
 - 1. When hydraulic seeder is used, seedbed preparation is not required.
 - 2. When surface soil has been sealed by rainfall or consists of smooth undisturbed cut slopes, and conventional or manual seeding is to be used, prepare seedbed by scarifying sufficiently to allow seed to lodge and germinate.
 - 3. If temporary mulching was used on planting area but not removed, apply nitrogen fertilizer at 1 pound per 1000 sq ft.
 - 4. On soils of very low fertility, apply 10-10-10 fertilizer at rate of 12 to 16 pounds per 1000 sq ft.
 - 5. Incorporate fertilizer into soil before seeding.
 - 6. Apply seed uniformly; if using drill or cultipacker seeders place seed 1/2 to 1 inch deep.
 - 7. Irrigate as required to thoroughly wet soil to depth that will ensure germination, without causing runoff or erosion.

8. Repeat irrigation as required until grass is established.

3.05 MAINTENANCE

- A. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches or more rainfall at the project site, and daily during prolonged rainfall.
- B. Repair deficiencies immediately.
- C. Silt Fences:
 - 1. Promptly replace fabric that deteriorates unless need for fence has passed.
 - 2. Remove silt deposits that exceed one-third of the height of the fence.
 - 3. Repair fences that are undercut by runoff or otherwise damaged, whether by runoff or other causes.
- D. Clean out temporary sediment control structures weekly and relocate soil on site.
- E. Place sediment in appropriate locations on site; do not remove from site.

3.06 CLEAN UP

- A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Engineer.
- B. Clean out temporary sediment control structures that are to remain as permanent measures.
- C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

SECTION 01 5719

TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Construction procedures to promote adequate indoor air quality after construction.
- B. Building flush-out after construction and before occupancy.
- C. Testing indoor air quality after completion of construction.

1.02 PROJECT GOALS

- A. Dust and Airborne Particulates: Prevent deposition of dust and other particulates in HVAC ducts and equipment.
 - 1. Cleaning of ductwork is not contemplated under this Contract.
 - 2. Contractor shall bear the cost of cleaning required due to failure to protect ducts and equipment from construction dust.
- B. Airborne Contaminants: Procedures and products have been specified to minimize indoor air pollutants.
 - 1. Furnish products meeting the specifications.
 - 2. Avoid construction practices that could result in contamination of installed products leading to indoor air pollution.

1.03 RELATED REQUIREMENTS

- A. Section 01 4000 Quality Requirements: Testing and inspection services.
- B. Section 01 6116 Volatile Organic Compound (VOC) Content Restrictions.

1.04 REFERENCE STANDARDS

- A. ASTM D5197 Standard Test Method for Determination of Formaldehyde and Other Carbonyl Compounds in Air (Active Sampler Methodology); 2021.
- B. CAL (CDPH SM) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers; 2017, v1.2.
- C. EPA 600/4-90/010 Compendium of Methods for the Determination of Air Pollutants in Indoor Air; 1990.
- D. EPA 625/R-96/010b Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air; 1999.
- E. SMACNA (OCC) IAQ Guidelines for Occupied Buildings Under Construction; 2007.

1.05 DEFINITIONS

- A. Adsorptive Materials: Gypsum board, acoustical ceiling tile and panels, carpet and carpet tile, fabrics, fibrous insulation, and other similar products.
- B. Contaminants: Gases, vapors, regulated pollutants, airborne mold and mildew, and the like, as specified.
- C. Particulates: Dust, dirt, and other airborne solid matter.
- D. Wet Work: Concrete, plaster, coatings, and other products that emit water vapor or volatile organic compounds during installation, drying, or curing.

1.06 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Indoor Air Quality Management Plan: Describe in detail measures to be taken to promote adequate indoor air quality upon completion; use SMACNA (OCC) as a guide.
 - 1. Submit not less than 60 days before enclosure of building.
 - 2. Identify potential sources of odor and dust.
 - 3. Identify construction activities likely to produce odor or dust.

- 4. Identify areas of project potentially affected, especially occupied areas.
- 5. Evaluate potential problems by severity and describe methods of control.
- 6. Describe construction ventilation to be provided, including type and duration of ventilation, use of permanent HVAC systems, types of filters and schedule for replacement of filters.
- 7. Describe cleaning and dust control procedures.
- C. Air Contaminant Test Plan: Identify:
 - 1. Testing agency qualifications.
 - 2. Locations and scheduling of air sampling.
 - 3. Test procedures, in detail.
 - 4. Test instruments and apparatus.
 - 5. Sampling methods.
- D. Air Contaminant Test Reports: Show:
 - 1. Location where each sample was taken, and time.
 - 2. Test values for each air sample; average the values of each set of 3.
 - 3. HVAC operating conditions.
 - 4. Certification of test equipment calibration.
 - 5. Other conditions or discrepancies that might have influenced results.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Low VOC Materials: See Section 01 6116.
- B. Low VOC Materials: See individual sections for specific requirements for materials with low VOC content.

PART 3 EXECUTION

3.01 CONSTRUCTION PROCEDURES

- A. Prevent the absorption of moisture and humidity by absorptive materials by:
 - 1. Sequencing the delivery of such materials so that they are not present in the building until wet work is completed and dry.
 - 2. Delivery and storage of such materials in fully sealed moisture-impermeable packaging.
 - 3. Provide sufficient ventilation for drying within reasonable time frame.
- B. Begin construction ventilation when building is substantially enclosed.
- C. If extremely dusty or dirty work must be conducted inside the building, shut down HVAC systems for the duration; remove dust and dirt completely before restarting systems.
- D. Use of HVAC equipment and ductwork for ventilation during construction is not permitted:
 - 1. Provide temporary ventilation equivalent to 1.5 air changes per hour, minimum.
 - 2. Exhaust directly to outside.
 - 3. Seal HVAC air inlets and outlets immediately after duct installation.
- E. Do not store construction materials or waste in mechanical or electrical rooms.
- F. Prior to use of return air ductwork without intake filters clean up and remove dust and debris generated by construction activities.
 - 1. Inspect duct intakes, return air grilles, and terminal units for dust.
 - 2. Clean plenum spaces, including top sides of lay-in ceilings, outsides of ducts, tops of pipes and conduit.
 - 3. Clean tops of doors and frames.
 - 4. Clean mechanical and electrical rooms, including tops of pipes, ducts, and conduit, equipment, and supports.
 - 5. Clean return plenums of air handling units.
 - 6. Remove intake filters last, after cleaning is complete.
- G. Do not perform dusty or dirty work after starting use of return air ducts without intake filters.

H. Use other relevant recommendations of SMACNA (OCC) for avoiding unnecessary contamination due to construction procedures.

3.02 BUILDING FLUSH-OUT

- A. Contractor's Option: Either full continuous flush-out OR satisfactory air contaminant testing is required, not both.
- B. Perform building flush-out before occupancy.
- C. Do not start flush-out until:
 - 1. All construction is complete.
 - 2. HVAC systems have been tested, adjusted, and balanced for proper operation.
 - 3. Inspection of inside of return air ducts and terminal units confirms that cleaning is not necessary.
 - 4. New HVAC filtration media have been installed.
- D. Building Flush-Out: Operate all ventilation systems at normal flow rates with 100 percent outside air until a total air volume of 14,000 cubic feet per square foot of floor area has been supplied.
 - 1. Obtain Owner's concurrence that construction is complete enough before beginning flush-out.
 - 2. Maintain interior temperature of at least 60 degrees F and interior relative humidity no higher than 60 percent.
 - 3. If additional construction involving materials that produce particulates or any of the specified contaminants is conducted during flush-out, start flush-out over.
 - 4. If interior spaces must be occupied prior to completion of the flush-out, supply a minimum of 25 percent of the total air volume prior to occupancy, and:
 - a. Begin ventilation at least three hours prior to daily occupancy.
 - b. Continue ventilation during all occupied periods.
 - c. Provide minimum outside air volume of 0.30 cfm per square foot or design minimum outside air rate, whichever is greater.
- E. Install new HVAC filtration media after completion of flush-out and before occupancy or further testing.

3.03 AIR CONTAMINANT TESTING

- A. Contractor's Option: Either full continuous flush-out, or satisfactory air contaminant testing is required, not both.
- B. Perform air contaminant testing before occupancy.
- C. Do not start air contaminant testing until:
 - 1. All construction is complete, including interior finishes.
 - 2. HVAC systems have been tested, adjusted, and balanced for proper operation.
 - 3. New HVAC filtration media have been installed.
- D. Indoor Air Samples: Collect from spaces representative of occupied areas:
 - 1. Collect samples while operable windows and exterior doors are closed, HVAC system is running normally as if occupied, with design minimum outdoor air, but with the building unoccupied.
 - 2. Collect samples from spaces in each contiguous floor area in each air handler zone, but not less than one sample per 25,000 square feet; take samples from areas having the least ventilation and those having the greatest presumed source strength.
 - 3. Collect samples from height from 36 inches to 72 inches above floor.
 - 4. Collect samples from same locations on 3 consecutive days during normal business hours; average the results of each set of 3 samples.
 - 5. Exception: Areas with normal very high outside air ventilation rates, such as laboratories, do not need to be tested.
 - 6. When retesting the same building areas, take samples from at least the same locations as in first test.

- E. Outdoor Air Samples: Collect samples at outside air intake of each air handler at the same time as indoor samples are taken.
- F. Analyze air samples and submit report.
- G. Air Contaminant Concentration Limits:
 - 1. Formaldehyde: Not more than 27 parts per billion.
 - 2. PM10 Particulates: Not more than 50 micrograms per cubic meter.
 - 3. Total Volatile Organic Compounds (TVOCs): Not more than 500 micrograms per cubic meter.
 - 4. Chemicals Listed in CAL (CDPH SM) Table 4-1, except Formaldehyde: Allowable concentrations listed in Table 4-1.
 - 5. Carbon Monoxide: Not more than 9 parts per million and not more than 2 parts per million higher than outdoor air.
- H. Air Contaminant Concentration Test Methods:
 - 1. Formaldehyde: ASTM D5197, EPA 625/R-96/010b Method TO-11A, or EPA 600/4-90/010 Method IP-6.
 - 2. Particulates: EPA 600/4-90/010 Method IP-10.
 - 3. Total Volatile Organic Compounds (TVOC): EPA 625/R-96/010b Method TO-1, TO-15, or TO-17; or EPA 600/4-90/010 Method IP-1.
 - 4. Chemicals Listed in CAL (CDPH SM) Table 4-1, except Formaldehyde: ASTM D5197, or EPA 625/R-96/010b Method TO-1, TO-15, or TO-17.
 - 5. Carbon Monoxide: EPA 600/4-90/010 Method IP-3, plus measure outdoor air; measure in ppm; report both indoor and outdoor measurements.
- I. Air Contaminant Concentration Determination and Limits:
 - 1. Carbon Monoxide: Not more than 9 parts per million and not more than 2 parts per million higher than outdoor air.
 - 2. Airborne Mold and Mildew: Measure in relation to outside air; not higher than outside air.
 - 3. Formaldehyde: Not more than 50 parts per billion.
 - 4. Formaldehyde: Measure in micrograms per cubic meter, in relation to outside air; not more than 20 micrograms per cubic meter higher than outside air.
 - 5. Total Volatile Organic Compounds (TVOC): Not more than 500 micrograms per cubic meter.
 - 6. Total Volatile Organic Compounds (TVOC): Measure in micrograms per cubic meter, in relation to outside air; not more than 200 micrograms per cubic meter higher than outside air.
 - 7. Particulates (PM10): Not more than 50 micrograms per cubic meter.
 - 8. Total Particulates (PM): Measure in micrograms per cubic meter, in relation to outside air; not more than 20 micrograms per cubic meter higher than outside air.

SECTION 01 6000 PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General product requirements.
- B. Transportation, handling, storage and protection.
- C. Product option requirements.
- D. Substitution limitations.
- E. Procedures for Owner-supplied products.
- F. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

- A. Section 01 1000 Summary: Identification of Owner-supplied products.
- B. Section 01 2500 Substitution Procedures: Substitutions made during procurement and/or construction phases.
- C. Section 01 4000 Quality Requirements: Product quality monitoring.
- D. Section 01 6023 Substitution Request Form
- E. Section 01 6116 Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.
- F. Section 01 7419 Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.

1.03 REFERENCE STANDARDS

- A. GreenSeal GS-36 Commercial Adhesives; Green Seal, Inc.; 2000.
- B. SCAQMD 1168 South Coast Air Quality Management District Rule No.1168; current edition; www.aqmd.gov.

1.04 SUBMITTALS

- A. Proposed Products List: Submit list of major products that comply with the specifications and are proposed for use, with name of manufacturer, trade name, and model number of each product.
 - 1. Submit within 15 days after date of Subcontract Award Notice.
 - 2. For products specified only by reference standards, list applicable reference standards.
- B. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- C. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- D. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
 - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by Contract Documents.
- B. Use of products having any of the following characteristics is not permitted:
 - 1. Made using or containing CFC's or HCFC's.
 - 2. Made of wood from newly cut old growth timber.

- 3. Containing lead, cadmium, or asbestos.
- C. Packaging:
 - 1. Where Contractor has the option to provide one of the listed products or equal, preference shall be given to products with minimal packaging and easily recyclable packaging as defined in ASTM D5834.
 - 2. Maximize use of source reduction and recycling procedures outlined in ASTM D5834.
- D. Where other criteria are met, Contractor shall give preference to products that:
 - 1. If used on interior, have lower emissions, as defined in Section 01 6116.
 - 2. If wet-applied, have lower VOC content, as defined in Section 01 6116.
 - 3. Are extracted, harvested, and/or manufactured closer to the location of the project.
 - 4. Have longer documented life span under normal use.
 - 5. Result in less construction waste. See Section 01 7419
 - 6. Are made of recycled materials.

2.02 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.03 MAINTENANCE MATERIALS

A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

A. See Section 01 2500 - Substitution Procedures.

3.02 OWNER-SUPPLIED PRODUCTS

- A. See Section 01 1000 Summary for identification of Owner-supplied products.
- B. Owner's Responsibilities:
 - 1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
 - 2. Arrange and pay for product delivery to site.
 - 3. On delivery, inspect products jointly with Contractor.
 - 4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
 - 5. Arrange for manufacturers' warranties, inspections, and service.
- C. Contractor's Responsibilities:
 - 1. Review Owner reviewed shop drawings, product data, and samples.
 - 2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
 - 3. Handle, store, install and finish products.
 - 4. Repair or replace items damaged after receipt.

3.03 TRANSPORTATION AND HANDLING

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.

- C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- D. Transport and handle products in accordance with manufacturer's instructions.
- E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
- H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.04 STORAGE AND PROTECTION

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 01 7419.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- G. Comply with manufacturer's warranty conditions, if any.
- H. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- I. Prevent contact with material that may cause corrosion, discoloration, or staining.
- J. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- K. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

SECTION 01 6023

SUBSTITUTION REQUEST FORM

SUBSTITUTION REQUEST: DATE SUBMITTED _____

1.01 SUBMIT TO: PIVOT ARCHITECTURE, 44 WEST BROADWAY #300, EUGENE OR 97401-3038

A. All Substitution Requests shall be submitted via e-mail to **bwardle@pivotarchitecture.com**.

1.02 PROJECT: RVTD TRANSPORTATION BUILDING

1.03 SPECIFIED ITEM:

- A. SECTION NAME AND NUMBER: ____
- B. PRODUCT TYPE AND NAME AND MODEL:

C. PARAGRAPH AND PRODUCT DESCRIPTION:

1.04 PROPOSED SUBSTITUTION:

- A. MANUFACTURER AND MODEL NUMBER(S):
- B. PRODUCT DESCRIPTION: _____
- C. Attached data includes product description, specifications, drawings, photographs, performance and test data adequate for evaluation of request including identification of applicable data portions. Attached data also includes description of changes to Contract Documents the proposed substitution requires for proper installation.

1.05 UNDERSIGNED CERTIFIES FOLLOWING ITEMS, UNLESS MODIFIED BY ATTACHMENTS, ARE CORRECT:

- A. Proposed substitution does not affect dimensions shown on the drawings.
- B. Undersigned pays for changes to building design, including engineering design, detailing, and construction costs caused by proposed substitution.
- C. Proposed substitution has no adverse effect on other trades, construction schedule, or specified warranty requirements.
- D. Maintenance and service parts are available locally or readily obtainable for proposed substitution.

1.06 UNDERSIGNED FURTHER CERTIFIES FUNCTION, APPEARANCE, AND QUALITY OF PROPOSED SUBSTITUTION ARE EQUIVALENT OR SUPERIOR TO SPECIFIED ITEM.

- 1.07 UNDERSIGNED FURTHER CERTIFIES THAT THE MANUFACTURER OF THE PROPOSED SUBSTITUTION IS AWARE OF THIS SUBSTITUTION REQUEST AND AGREES TO THE STATEMENTS NOTED ABOVE.
- 1.08 UNDERSIGNED AGREES THAT THE TERMS AND CONDITIONS FOR SUBSTITUTIONS FOUND IN BIDDING DOCUMENTS APPLY TO THIS PROPOSED SUBSTITUTION.

1.09 SUBMITTED BY:

- A. NAME:
 - A. NAME: ______ SIGNATURE:______
 - B. FIRM NAME:
 - C. FULL MAILING ADDRESS:
 - D. PHONE: E-MAIL:

1.10 FOR USE BY ARCHITECT OR ENGINEER

- A. APPROVED OR APPROVED AS NOTED BY:
- B. NOT APPROVED BY: _____

- C. RECEIVED TOO LATE: _____
- D. REMARKS: _____
- E. DATE OF RESPONSE: _____

SECTION 01 6116

VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. VOC restrictions for product categories listed below under "DEFINITIONS."
- B. All products of each category that are installed in the project must comply; Owner's project goals do not allow for partial compliance.

1.02 RELATED REQUIREMENTS

- A. Section 01 3000 Administrative Requirements: Submittal procedures.
- B. Section 01 4000 Quality Requirements: Procedures for testing and certifications.
- C. Section 01 5721 Indoor Air Quality Controls: Procedures and testing.
- D. Section 01 6000 Product Requirements: Fundamental product requirements, substitutions and product options, delivery, storage, and handling.

1.03 DEFINITIONS

- A. VOC-Restricted Products: All products of each of the following categories when installed or applied on-site in the building interior:
 - 1. Adhesives, sealants, and sealer coatings.
 - 2. Carpet.
 - 3. Carpet tile.
 - 4. Resilient floor coverings.
 - 5. Paints and coatings.
 - 6. Insulation.
 - 7. Gypsum board.
 - 8. Acoustical ceilings and panels.
 - 9. Cabinet work.
 - 10. Wall coverings.
 - 11. Composite wood and agrifiber products used either alone or as part of another product.
 - 12. Other products when specifically stated in the specifications.
- B. Interior of Building: Anywhere inside the exterior weather barrier.
- C. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.
- D. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.

1.04 REFERENCE STANDARDS

- A. CRI (GLP) Green Label Plus Testing Program Certified Products; Current Edition.
- B. GreenSeal GC-03 Anti-Corrosive Paints; Green Seal, Inc.; 2007
- C. GreenSeal GS-11 Paints; Green Seal, Inc.; 1993.
- D. GreenSeal GS-36 Standard for Adhesives for Commercial Use; 2013.
- E. SCAQMD 1113 Architectural Coatings; 1977, with Amendment (2016).
- F. SCAQMD 1168 Adhesive and Sealant Applications; 1989 (Amended 2017).
- G. SCS (CPD) SCS Certified Products; Current Edition.

1.05 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Evidence of Compliance: Submit for each different product in each applicable category.
- C. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.

PART 2 PRODUCTS

2.01 MATERIALS

- A. All Products: Comply with the most stringent of federal, State, and local requirements, or these specifications.
- B. Adhesives and Joint Sealants: Provide only products having volatile organic compound (VOC) content not greater than required by South Coast Air Quality Management District Rule No.1168.
 - 1. Definition: This provision applies to gunnable, trowelable, and liquid-applied adhesives, sealants, and sealant primers used anywhere on the interior of the building inside the weather barrier, including duct sealers and fire stopping.
 - 2. LEED: This provision is applicable to LEED Credit EQ 4.1; submit LEED Prohibited Content Installer Certification Forms and all support material per section 01 35 16.07.
 - 3. Certification: Require each installer to certify compliance and submit product data showing product content.
 - a. Evidence of Compliance: Acceptable types of evidence are:
 - 1) Report of laboratory testing performed in accordance with requirements.
 - 2) Published product data showing compliance with requirements.
 - 3) Certification by manufacturer that product complies with requirements.
 - 4. SCAQMD limits for specific product categories:
 - a. Architectural Applications VOC Limit g/L less water
 - 1) Indoor Carpet Adhesives 50
 - 2) Carpet Pad Adhesives 50
 - 3) Outdoor Carpet Adhesives 150
 - 4) Wood Flooring Adhesive 100
 - 5) Rubber Floor Adhesives 60
 - 6) Subfloor Adhesives 50
 - 7) Ceramic Tile Adhesives 65
 - 8) VCT and Asphalt Tile Adhesives 50
 - 9) Dry Wall and Panel Adhesives 50
 - 10) Cove Base Adhesives 50
 - 11) Multipurpose Construction Adhesives 70
 - 12) Structural Glazing Adhesives 100
 - 13) Single Ply Roof Membrane Adhesives 250
 - b. Specialty Applications VOC Limits g/L less water
 - 1) PVC Welding 510
 - 2) CPVC Welding 490
 - 3) ABS Welding 325
 - 4) Plastic Cement Welding 250
 - 5) Adhesive Primer for Plastic 550
 - 6) Computer Diskette Manufacturing 350
 - 7) Contact Adhesive 80
 - 8) Special Purpose Contact Adhesive 250
 - 9) Tire Retread 100
 - 10) Adhesive Primer for Traffic Marking Tape150
 - 11) Structural Wood Member Adhesive140
 - 12) Sheet Applied Rubber Lining Operations 850
 - 13) Top and Trim Adhesive 250
 - c. Substrate Specific Applications VOC Limit g/L less water
 - 1) Metal to Metal 30
 - 2) Plastic Foams 50
 - 3) Porous Material (except wood) 50
 - 4) Wood 30

- 5) Fiberglass 80
- d. Sealants VOC Limit g/L less water
 - 1) Architectural 250
 - 2) Marine Deck 760
 - 3) Nonmembrane Roof 300
 - 4) Roadway 250
 - 5) Single-Ply Roof Membrane 450
 - 6) Other 420
- e. Sealant Primers VOC Limit g/L less water
 - 1) Architectural Non Porous 250
 - 2) Architectural Porous 775
 - 3) Modified Bituminous 500
 - 4) Marine Deck 760
 - 5) Other 750
- C. Aerosol Adhesives: Provide only products having volatile organic compound (VOC) content not greater than required by GreenSeal GS-36.
 - 1. LEED: This provision is applicable to LEED Credit EQ 4.1; submit LEED Prohibited Content Installer Certification Forms and all support material per section 01 35 16.07
 - 2. Certification: Require each installer to certify compliance and submit product data showing product content.
 - a. Evidence of Compliance: Acceptable types of evidence are:
 - 1) Current GreenSeal Certification.
 - 2) Report of laboratory testing performed in accordance with GreenSeal GS-36 requirements.
 - 3) Published product data showing compliance with requirements.
 - 3. GreenSeal limits for specific product categories:
 - a. Aerosol Adhesives VOC Weight g/L minus water
 - 1) General purpose mist spray 65% VOCs by weight
 - 2) General purpose web spray 55% VOCs by weight
 - 3) Special purpose aerosol adhesives (all types) 70% VOCs by weight
- D. Paints and Coatings:
 - 1. Definition: This provision applies to paints and coatings used anywhere on the interior of the building inside the weather barrier, including all primers and sealers.
 - 2. Provide coatings that comply with the most stringent requirements specified in the following:
 - a. Architectural Paints and Coatings: Do not exceed VOC content limits established in GreenSeal GS-11.
 - b. Anti-Corrosive and Anti-Rust Paints: Do not exceed VOC content limits established in GreenSeal GS-03.
 - c. Clear Wood Finishes, Floor Coatings, Stains, Primers and Shellacs: Do not exceed the VOC content limits established in SCAQMD Rule No. 1113.
 - 3. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
 - 4. This provision is applicable to LEED Credit EQ 4.1; submit LEED Prohibited Content Installer Certification Forms and all support material per section 01 35 16.07.
 - 5. Certification: Require each installer to certify compliance and submit product data showing product content.
 - a. Evidence of Compliance: Acceptable types of evidence are:
 - 1) Report of laboratory testing performed in accordance with requirements.
 - 2) Published product data showing compliance with requirements.
 - 6. Limits for specific product categories:

- a. Architectural paints, coatings and primers applied to interior walls and ceilings per GreenSeal GS-11
 - 1) Flats: 50 g/L
 - 2) Non-Flats: 150 g/L
 - 3) Primers 50 g/L
- b. Interior Anti-Corrosive and Anti-rust paints, coatings and primers per GreenSeal GS-03, Anti-Corrosive Paints
 - 1) 250 g/L
- c. All other coatings, paints and sealers per SCAQMD Rule #1113, Architectural Coatings
 - 1) Coating Category VOC Limit g/L
 - (a) Bond Breakers 350
 - (b) Clear Wood Finishes 275
 - (c) Varnish 275
 - (d) Sanding Sealers 275
 - (e) Lacquer 275
 - (f) Clear Brushing Lacquer 275
 - (g) Concrete-Curing Compounds 100
 - (h) Concrete-Curing Compounds For Roadways and Bridges 350
 - (i) Dry-Fog Coatings 150
 - (j) Fire-Proofing Exterior Coatings 350
 - (k) Fire-Retardant Coatings Clear 650
 - (I) Fire-Retardant Coatings Pigmented 350
 - (m) Flats 50
 - (n) Floor Coatings 50
 - (o) Graphic Arts (Sign) Coatings 500
 - (p) Industrial Maintenance (IM) Coatings 100
 - (q) High Temperature IM Coatings 420
 - (r) Zinc-Rich IM Primers 100
 - (s) Japans/Faux Finishing Coatings 350
 - (t) Magnesite Cement Coatings 450
 - (u) Mastic Coatings 300
 - (v) Metallic Pigmented Coatings 500
 - (w) Multi-Color Coatings 250
 - (x) Nonflat Coatings 50
 - (y) Nonflat High Gloss 50
 - (z) Pigmented Lacquer 275
 - (aa) Pre-Treatment Wash Primers420
 - (ab) Primers, Sealers, and Undercoaters 100
 - (ac) Quick-Dry Enamels 50
 - (ad) Quick-Dry Primers, Sealers, and Undercoaters 100
 - (ae) Recycled Coatings 250
 - (af) Roof Coatings50
 - (ag) Roof Coatings, Aluminum 100
 - (ah) Roof Primers, Bituminous 350
 - (ai) Rust Preventative Coatings 100
 - (aj) Shellac Clear 730
 - (ak) Shellac Pigmented 550
 - (al) Specialty Primers 100
 - (am)Stains 100
 - (an) Stains, Interior 250
 - (ao) Swimming Pool Coatings Repair 340
 - (ap) Swimming Pool Coatings Other 340

- (aq) Traffic Coatings 100
- (ar) Waterproofing Sealers 100
- (as) Waterproofing Concrete/Masonry Sealers 100
- (at) Wood Preservatives Below-Ground 350
- (au) Wood Preservatives- Other 350
- (av) Low-Solids Coating 120
- E. Carpet and Adhesive: Provide products having VOC content not greater than that required for CRI Green Label Plus certification.
 - 1. Evidence of Compliance: Acceptable types of evidence are:
 - a. Current Green Label Plus Certification.
 - b. Report of laboratory testing performed in accordance with requirements.
- F. Carpet Tile and Adhesive: Provide products having VOC content not greater than that required for CRI Green Label Plus certification.
 - 1. Evidence of Compliance: Acceptable types of evidence are:
 - a. Current Green Label Plus Certification.
 - b. Report of laboratory testing performed in accordance with requirements.
- G. Composite Wood and Agrifiber Products and Adhesives Used for Laminating Them: Provide products having no added urea-formaldehyde resins.
 - 1. Evidence of Compliance: Acceptable types of evidence are:
 - a. Current SCS "No Added Urea Formaldehyde" certification; www.scscertified.com.
 - b. Published product data showing compliance with requirements.
- H. Other Product Categories: Comply with limitations specified elsewhere.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Owner reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to Owner.
- B. Additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

SECTION 01 7000 EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Pre-installation meetings.
- C. Surveying for laying out the work.
- D. Cleaning and protection.
- E. Starting of systems and equipment.
- F. Demonstration and instruction of Owner personnel.
- G. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.
- H. General requirements for maintenance service.
- I. Substantial completion
- J. Final Completion
- K. Additional fees for delays in completing work

1.02 RELATED REQUIREMENTS

- A. Section 01 1000 Summary: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.
- B. Section 01 3000 Administrative Requirements: Submittals procedures, Electronic document submittal service.
- C. Section 01 4000 Quality Requirements: Testing and inspection procedures.
- D. Section 01 5000 Temporary Facilities and Controls: Temporary exterior enclosures.
- E. Section 01 5000 Temporary Facilities and Controls: Temporary interior partitions.
- F. Section 01 5100 Temporary Utilities: Temporary heating, cooling, and ventilating facilities.
- G. Section 01 7419 Construction Waste Management and Disposal: Additional procedures for trash/waste removal, recycling, salvage, and reuse.
- H. Section 01 7800 Closeout Submittals: Project record documents, operation and maintenance data, warranties, and bonds.
- I. Section 01 9113 General Commissioning Requirements: Contractor's responsibilities in regard to commissioning.
- J. Section 07 8400 Firestopping.

1.03 REFERENCE STANDARDS

A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022, with Errata (2021).

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
 - 1. On request, submit documentation verifying accuracy of survey work.
 - 2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in compliance with Contract Documents.
 - 3. Submit surveys and survey logs for the project record.
- C. Project Record Documents: Accurately record actual locations of capped and active utilities.

01 7000 - 1

1.05 QUALIFICATIONS

A. For surveying work, employ a land surveyor registered in the State in which the Project is located and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,

1.06 PROJECT CONDITIONS

- A. Use of explosives is not permitted.
- B. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- C. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
- D. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- E. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
 - 1. Provide dust-proof enclosures to prevent entry of dust generated outdoors.
- F. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
- G. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
 - 1. Outdoors: Limit conduct of especially noisy exterior work to the hours of 8 am to 5 pm.
- H. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.
- I. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.07 COORDINATION

- A. See Section 01 1000 for occupancy-related requirements.
- B. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements.
- C. Notify affected utility companies and comply with their requirements.
- D. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- E. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- G. Coordinate completion and clean-up of work of separate sections.
- H. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.08 CONTRACTOR'S FULL TIME SUPERVISION OF THE WORK

- A. Contractor shall provide an on-site project superintendent to be present full time whenever work is occurring on site.
- B. Contractor's Superintendent shall maintain a Daily Log of work activities at the site during construction.
 - 1. Submit copies of the Daily Logs to the Owner on a weekly basis.

PART 2 PRODUCTS

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Examine and verify specific conditions described in individual specification sections.
- C. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- D. Verify that utility services are available, of the correct characteristics, and in the correct locations.

3.02 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 PREINSTALLATION MEETINGS

- A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Architect four days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
 - 1. Review conditions of examination, preparation and installation procedures.
 - 2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- F. Utilize recognized engineering survey practices.
- G. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
 - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
 - 2. Grid or axis for structures.

- 3. Building foundation, column locations, ground floor elevations.
- H. Periodically verify layouts by same means.
- I. Maintain a complete and accurate log of control and survey work as it progresses.

3.05 GENERAL INSTALLATION REQUIREMENTS

- A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.06 CUTTING AND PATCHING

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. Perform whatever cutting and patching is necessary to:
 - 1. Complete the work.
 - 2. Fit products together to integrate with other work.
 - 3. Provide openings for penetration of mechanical, electrical, and other services.
 - 4. Match work that has been cut to adjacent work.
 - 5. Repair areas adjacent to cuts to required condition.
 - 6. Repair new work damaged by subsequent work.
 - 7. Remove samples of installed work for testing when requested.
 - 8. Remove and replace defective and non-complying work.
- C. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- D. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces. Where existing warranties are still in effect employ manufacturer authorzed installer to perform this work.
- E. Cut concrete, masonry and other similar rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- F. Restore work with new products in accordance with requirements of Contract Documents.
- G. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- H. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 8400, to full thickness of the penetrated element.
- I. Sawcutting:
 - 1. Employ experienced sawcutting contractor to make all holes, or slab and pavement cutting shown in drawings for architectural, structural, mechanical and electrical work.
 - 2. Do not use water saws in occupied areas, unless otherwise approved.
 - 3. Cut openings square and plumb with sharp edges. Minimize overcutting at corners.
 - 4. Verify location of existing utilities in work area and make proper precautions to protect, disconnect and relocate, or terminate services as directed.
- J. Patching:
 - 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly or defined section, refinish entire unit.
 - 2. Match color, texture, and appearance.

- 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.
- K. Maintain adequate Temporary Support necessary to assure structural integrity of affected Work.
- L. Protect other portions of Project Work against damage and discoloration.
- M. Protect Work exposed to cutting against damage and discoloration.
- N. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly or defined section, refinish entire unit.
- O. Make neat transitions. Patch work to match adjacent work in texture and appearance. Where new work abuts or aligns with existing, perform a smooth and even transition.
- P. Patch or replace surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. Repair substrate prior to patching finish. Finish patches to produce uniform finish and texture over entire area. When finish cannot be matched, refinish entire surface to nearest intersections.

3.07 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.08 PROTECTION OF INSTALLED WORK

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- G. Prohibit traffic from landscaped areas.
- H. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.09 SYSTEM STARTUP

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Architect and Owner seven days prior to start-up of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.

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- F. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.10 DEMONSTRATION AND INSTRUCTION

- A. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.
- B. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.
- C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- D. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner's personnel.
- E. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
- F. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.
- G. The amount of time required for instruction on each item of equipment and system is that specified in individual sections.

3.11 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.
- B. Testing, adjusting, and balancing HVAC systems: See Section 23 0593 Testing, Adjusting, and Balancing for HVAC.

3.12 FINAL CLEANING

- A. Use cleaning materials that are nonhazardous.
- B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- C. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- D. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- E. Clean interior floors in accordance with flooring manufacturer instructions.
- F. Clean filters of operating equipment.
- G. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.
- H. Clean site; sweep paved areas, rake clean landscaped surfaces.
- I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.13 CLOSEOUT PROCEDURES

- A. Make submittals that are required by governing or other authorities.
 - 1. Provide copies to Architect and Owner.

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B. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.

3.14 SUBSTANTIAL COMPLETION

- A. Notify Architect when work is considered ready for Substantial Completion.
- B. Submit written certification that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's review.
- C. Complete all required maintenance work prior to the date of substantial completion.
- D. When Contractor considers Work substantially complete, as defined in General Conditions, submit to the Architect:
 - 1. Written notice that Work, or designated portion thereof, is substantially complete.
 - 2. List of Items to be completed or corrected.
 - 3. Copy of Final or Temporary Occupancy Permit.
- E. Architect will, as soon as possible thereafter, make an observation visit to the site to determine completion status.
- F. Should Architect determine that Work is not substantially complete:
 - 1. Architect will promptly notify Contractor in writing, giving reasons therefore.
 - 2. Contractor shall remedy Work deficiencies, and send second notice of substantial completion to Architect.
 - 3. Architect will review the corrected work.
- G. When Architect concurs that Work is substantially complete, Architect will:
 - 1. Prepare Certificate of Substantial Completion, accompanied by Contractor's list of items to be completed or corrected, as verified and amended by Architect.
 - 2. Submit Certificate to Owner and Contractor for their written acceptance of the responsibilities assigned to them in the Certificate.
- H. Correct items of work listed in executed Certificates of Substantial Completion and comply with requirements for access to Owner-occupied areas.

3.15 FINAL ACCEPTANCE

- A. When Contractor considers Work complete, submit written certification to Architect and Owner that:
 - 1. Contract Documents have been reviewed.
 - 2. Contractor has inspected Work for compliance with Contract Documents.
 - 3. Work has been completed in accordance with Contract Documents.
 - 4. Equipment and Systems have been tested in presence of Owner's Representative and are operational.
 - 5. Work is complete and ready for final inspection.
- B. Architect will, as soon as possible thereafter, make an observation visit to the site to determine completion status.
- C. Should Architect consider Work incomplete or defective:
 - 1. Architect will promptly notify Contractor in writing, listing incomplete or defective Work.
 - 2. Contractor shall immediately remedy deficiencies, and send second written certification to Architect that Work is complete.
 - 3. Architect will review the corrected Work.
- D. Notify Architect when work is considered finally complete.
- E. When Architect finds Work acceptable under Contract Documents, Architect will request Contractor to make final closeout submittals.

3.16 ADDITIONAL FEES FOR DELAYS IN COMPLETING THE WORK

A. Architect will make 2 visits to the project site, one at Substantial Completion and one at Final Completion.

- B. Should Architect be required to make more than the stated 2 final site visits due to Contractor's failure to correct specified deficiencies:
 - 1. Owner will compensate Architect for additional services.
 - 2. Owner will deduct Architect's compensation amount from Contractor's final payment as follows:
 - a. Principal's time at \$200.00 per hour.
 - b. Employees' time at \$125.00 per hour.
 - c. Consultant employees and Others at 1.1 times the direct cost incurred.
 - d. Charges will be made for necessary travel time, commercial air fare, auto expense computed at 58 cents per mile, room and board, and all other expenses incurred in making inspections.

SECTION 01 7419

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.01 WASTE MANAGEMENT REQUIREMENTS

- A. Owner requires that this project generate the least amount of trash and waste possible.
- B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
- C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
- D. Required Recycling, Salvage, and Reuse: The following may not be disposed of in landfills or by incineration:
 - 1. Aluminum and plastic beverage containers.
 - 2. Corrugated cardboard.
 - 3. Wood pallets.
 - 4. Clean dimensional wood.
 - 5. Land clearing debris, including brush, branches, logs, and stumps; see Section 31 1000 Site Clearing for use options.
 - 6. Metals, including packaging banding, metal studs, sheet metal, structural steel, piping, reinforcing bars, door frames, and other items made of steel, iron, galvanized steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
 - 7. Fluorescent lamps (light bulbs).
- E. Contractor shall submit periodic Waste Disposal Reports; all landfill disposal, recycling, salvage, and reuse must be reported regardless of to whom the cost or savings accrues; use the same units of measure on all reports.
- F. Contractor shall develop and follow a Waste Management Plan designed to implement these requirements.
- G. Methods of trash/waste disposal that are not acceptable are:
 - 1. Burning on the project site.
 - 2. Burying on the project site.
 - 3. Dumping or burying on other property, public or private.
 - 4. Other illegal dumping or burying.
 - 5. Incineration, either on- or off-site.
 - 6. Use of Owner's trash receptacles.
- H. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.02 RELATED REQUIREMENTS

- A. Section 01 3000 Administrative Requirements: Additional requirements for project meetings, reports, submittal procedures, and project documentation.
- B. Section 01 5000 Temporary Facilities and Controls: Additional requirements related to trash/waste collection and removal facilities and services.
- C. Section 01 6000 Product Requirements: Waste prevention requirements related to delivery, storage, and handling.
- D. Section 01 7000 Execution and Closeout Requirements: Trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

1.03 DEFINITIONS

A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.

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- B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.
- C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.
- D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.
- E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
- F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- I. Return: To give back reusable items or unused products to vendors for credit.
- J. Reuse: To reuse a construction waste material in some manner on the project site.
- K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
- M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
- N. Toxic: Poisonous to humans either immediately or after a long period of exposure.
- O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Submit Waste Management Plan within 10 calendar days after receipt of Notice of Award of Bid, or prior to any trash or waste removal, whichever occurs sooner; submit projection of all trash and waste that will require disposal and alternatives to landfilling.
- C. Waste Management Plan: Include the following information:
 - 1. Analysis of the trash and waste projected to be generated during the entire project construction cycle, including types and quantities.
 - 2. Landfill Options: The name, address, and telephone number of the landfill(s) where trash/waste will be disposed of, the applicable landfill tipping fee(s), and the projected cost of disposing of all project trash/waste in the landfill(s).
 - 3. Landfill Alternatives: List all waste materials that will be diverted from landfills by reuse, salvage, or recycling.
- D. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
 - 1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
 - 2. Submit Report on a form acceptable to Owner.
 - Landfill Disposal: Include the following information:
 a. Identification of material.

- b. Amount, in tons or cubic yards, of trash/waste material from the project disposed of in landfills.
- c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
- d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
- 4. Recycled and Salvaged Materials: Include the following information for each:
 - a. Identification of material, including those retrieved by installer for use on other projects.
 - b. Amount, in tons or cubic yards, date removed from the project site, and receiving party.
 - c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
- 5. Material Reused on Project: Include the following information for each:
 - a. Identification of material and how it was used in the project.
 - b. Amount, in tons or cubic yards.
 - c. Include weight tickets as evidence of quantity.
- 6. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 WASTE MANAGEMENT PLAN IMPLEMENTATION

- A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.
- B. Spill Response Planning Establish spill prevention and cleanup procedures. Identify all potential spill areas and develop procedures for avoiding and responding to spills should they occur.
- C. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.
- D. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.
- E. Meetings: Discuss trash/waste management goals and issues at project meetings.
 - 1. Prebid meeting.
 - 2. Preconstruction meeting.
 - 3. Regular job-site meetings.
- F. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
 - 1. Provide containers as required.
 - 2. Provide adequate space for pick-up and delivery and convenience to subcontractors.
 - 3. If an enclosed area is not provided, clearly lay out and label a specific area on-site.
 - 4. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.
- G. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.
- H. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.
- I. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.
- J. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

SECTION 01 7800 CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Project record documents.
- B. Operation and maintenance data.
- C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

- A. Section 00 7200 General Conditions: Performance bond and labor and material payment bonds, warranty, and correction of work.
- B. Section 01 3000 Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- C. Section 01 7000 Execution and Closeout Requirements: Contract closeout procedures.
- D. Individual Product Sections: Specific requirements for operation and maintenance data.
- E. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

- A. Substantial Completion will not commence before the Operations and Maintenance Manuals, Warranties, and the Record Drawings are submitted in accordance with this section Administrative Requirements Section 01 3000.
- B. Project Record Documents: Submit documents to Architect Prior to Date of Substantial Completion.
- C. Operation and Maintenance Data:
 - 1. Submit one digital copy of preliminary draft or proposed formats and outlines of contents to Architect before start of Work preparing the O&M Data. Architect will review draft and return the one copy with comments. Architect will review draft and return any comments.
 - 2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
 - 3. Submit one digital draft copy of complete Operation and Maintenance documents to Architect at least 30 days prior to scheduled Date of Substantial Completion. This copy will be reviewed and returned , with Architect comments. Revise content of all document sets as required prior to final submission.
 - 4. Final Submittal: Prior to the Date of Substantial Completion submit three digital copies in PDF file format on CD or USB drives, and three paper sets of revised final documents in final form to Architect. After final review Architect will transfer this material to Owner.
 - 5. Either the draft copy or the final copy of the O&M manuals must be on the project site during any of the operator training scheduled for the project.
- D. Warranties and Bonds:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
 - 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.
 - 4. Submit three digital copies in PDF file format on CD or DVD discs, and three paper sets of final documents.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
- B. Maintenance of documents and samples.
 - 1. Store in Contractor's Field Office apart from Documents used for Construction.
 - 2. Provide Files, Shelving and Cabinets necessary to safely and securely store Documents and Samples.
 - 3. Maintain Documents in a clean, dry, legible, and good order.
 - 4. Do not use Record Documents for Construction Purposes.
 - 5. Make Documents available at all times for Architect's review.
- C. Ensure entries are complete and accurate, enabling future reference by Owner.
- D. Store record documents separate from documents used for construction.
- E. Record information concurrent with construction progress.
- F. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates utilized.
 - 3. Changes made by Addenda and modifications.
- G. Record Drawings: Legibly mark each item to record actual construction including:
 - 1. Measured depths of foundations in relation to finish first floor datum.
 - 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - 4. Field changes of dimension and detail.
 - 5. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

- A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

- A. For Each Product, Applied Material, and Finish:
 - 1. Product data, with catalog number, size, composition, and color and texture designations.
 - 2. Information for re-ordering custom manufactured products.
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.

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- C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.
- D. Additional information as specified in individual product specification sections.
- E. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- F. Provide a listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. In addition to requirements called for in other sections of this manual, provide the following:
- B. For Each Item of Equipment and Each System:
 - 1. Description of unit or system, and component parts.
 - 2. Identify function, normal operating characteristics, and limiting conditions.
 - 3. Include performance curves, with engineering data and tests.
 - 4. Complete nomenclature and model number of replaceable parts.
- C. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- D. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- E. Include color coded wiring diagrams as installed.
- F. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- G. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- H. Provide servicing and lubrication schedule, and list of lubricants required.
- I. Include manufacturer's printed operation and maintenance instructions.
- J. Include sequence of operation by controls manufacturer.
- K. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- L. Provide control diagrams by controls manufacturer as installed.
- M. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.
- N. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- O. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- P. Include test and balancing reports.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

- A. Assemble paper copies of operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
- B. Where systems involve more than one specification section, provide separate tabbed divider for each system.

- C. Prepare instructions and data by personnel experienced in maintenance and operation of described products.
- D. Prepare data in the form of an instructional manual.
- E. Digital O&M Manuals: In addition to binders described herein, prepare manuals as PDF documents organized similar to the printed manuals. Copy to one or more properly labeled CD or DVD discs.
 - 1. Digital O&M Manuals shall contain a searchable Table of Contents
 - 2. Digital copies of O&M Manuals must be organized by section.
 - 3. All markup of final PDF documents shall be produced using appropriate PDF editing software, and shall not handwritten. Final PDF documents shall not be scanned copies of original documents, but shall be submitted in their original digital form and remain fully searchable using PDF viewing software in common use.
- F. Paper & 3 Ring Binder O&M Manuals: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- G. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- H. Project Directory: Title and address of Project; names, addresses, e-mail addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
- I. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
- J. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- K. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.
- L. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- M. Arrange content by systems under section numbers and sequence of Table of Contents of this Project Manual.
- N. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, in three parts as follows:
 - 1. Part 1: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - f. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 - 2. Part 2: Project documents and certificates, including the following:
 - a. Shop drawings and product data.
 - b. Air and water balance reports.
 - c. Certificates.
 - d. Photocopies of warranties and bonds.
- O. Provide a listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.

P. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Architect, Consultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

3.06 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and when required have been are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.
- E. Manual: Bind in commercial quality 8-1/2 by 11 inch three D side ring binders with durable plastic covers.
- F. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.
- G. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.
- H. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

3.07 EVIDENCE OF PAYMENTS & RELEASE OF LIENS

- A. Contractor shall submit the following:
 - 1. Contractor's Affidavit of Payment of Debts and Claims, AIA Document G-706. A copy of this Form is bound in the Appendix Section of this manual.
 - 2. Contractor's Affidavit of Release of Liens, AIA Document G-706A, bound in the Appendix Section of this manual, including the following:
 - a. Consent of Contractor's Surety to Final Payment, AIA Document G-707, bound in the Appendix Section of this manual.
 - b. Contractor's Release or Waiver of Liens.
 - c. Separate releases or waivers of lien for Subcontractors, Suppliers, and others with lien rights against Owner's Property, together with list of those parties.
 - 3. Duly sign and execute all Submittals, before delivery to Architect.

3.08 CONTRACTOR'S CLOSEOUT SUBMITTALS TO ARCHITECT

- A. Wage Certification: Section 00 7343 and 01 2000.
- B. Certificate of Domestic Water Disinfection. See Division 33.
- C. Building Official's Certificate of Mechanical & Electrical Inspections.
- D. Building Official's Certificate of Occupancy.

3.09 SPARE PART & MAINTENANCE MATERIAL SUBMITTALS TO OWNER

- A. All spare parts and extra material are to be delivered to the owner prior to the date of substantial completion. Provide written confirmation of delivery, noting quantity and description as well as storage location. Obtain written acceptance from Owner for receipt of stored items.
- B. Specific Requirements: See Specifications Sections.
- C. Products: Identical to those included in Project Work.
- D. Storage Location: Where directed by Owner.

E. Required Submittals: See Specification Sections.

3.10 PROPRIETARY TOOLS AND SOFTWARE

A. Provide all proprietary tools, software, and diagnostic equipment necessary for the Owner to perform routine maintenance, repairs, and trouble shooting of equipment and systems that are installed as part of this work.

3.11 FINAL ADJUSTMENT OF ACCOUNTS

- A. Submit final statement of accounting to Architect, including the following:
 - 1. Original Contract Sum.
 - 2. Additions and deductions resulting from:
 - a. Previous Change Orders.
 - b. Adjustments to Cash Allowances
 - c. Other adjustments.
 - d. Deductions for uncompleted Work.
 - e. Deductions for Reinspection Payments.
 - 3. Total Contract Sum, as adjusted.
 - 4. Previous Payments.
 - 5. Sum remaining due.
- B. Architect will prepare and issue final Change Order, reflecting approved adjustments to Contract Sum not previously made by Change Orders.

3.12 FINAL APPLICATION FOR PAYMENT

A. Follow procedures specified in Section 01 2000.

SECTION 02 4100 DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Selective demolition of building elements for alteration purposes.

1.02 RELATED REQUIREMENTS

- A. Section 01 1000 Summary: Limitations on Contractor's use of site and premises.
- B. Section 01 5000 Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- C. Section 01 5713 Temporary Erosion and Sediment Control.
- D. Section 01 7000 Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.
- E. Section 31 2323 Fill: Fill material for filling holes, pits, and excavations generated as a result of removal operations.

1.03 DEFINITIONS

- A. Demolition: Dismantle, raze, destroy or wreck any building or structure or any part thereof.
- B. Remove: Detach or dismantle items from existing construction and dispose of them off site, unless items are indicated to be salvaged or reinstalled.
- C. Remove and Salvage: Detach or dismantle items from existing construction in a manner to prevent damage. Clean, package, label and deliver salvaged items to Owner in ready-for-reuse condition.
- D. Remove and Reinstall: Detach or dismantle items from existing construction in a manner to prevent damage. Clean and prepare for reuse and reinstall where indicated.

1.04 REFERENCE STANDARDS

- A. 29 CFR 1926 Safety and Health Regulations for Construction; Current Edition.
- B. NFPA 241 Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022, with Errata (2021).

1.05 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements for submittal procedures.
- B. Site Plan: Indicate:
 - 1. Areas for temporary construction and field offices.
- C. Demolition Plan: Submit demolition plan as required by OSHA and local AHJs.
 - 1. Indicate extent of demolition, removal sequencing, bracing and shoring, and location and construction of barricades and fences.
- D. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

PART 2 PRODUCTS

2.01 MATERIALS

A. Fill Material: See Section 31 2323.

PART 3 EXECUTION

3.01 DEMOLITION

- A. Miscellenous storage sheds as shown on drawings
- B. Remove paving and curbs required to accomplish new work.

- C. Outside area of new construction, remove foundation walls and footings to minimum 2 feet below finished grade.
- D. Remove concrete slabs on grade within construction limits indicated on drawings.
- E. Remove other items indicated, for salvage, relocation, and recycling.
- F. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as specified in Section 31 2323.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Use of explosives is not permitted.
 - 3. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 - 4. Provide, erect, and maintain temporary barriers and security devices.
 - 5. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 - 6. Do not close or obstruct roadways or sidewalks without permits from authority having jurisdiction.
 - 7. Conduct operations to minimize obstruction of public and private entrances and exits. Do not obstruct required exits at any time. Protect persons using entrances and exits from removal operations.
 - 8. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon, or limit access to their property.
- B. Do not begin removal until receipt of notification to proceed from Owner.
- C. Protect existing structures and other elements to remain in place and not removed.
 - 1. Provide bracing and shoring.
 - 2. Prevent movement or settlement of adjacent structures.
 - 3. Stop work immediately if adjacent structures appear to be in danger.
- D. Minimize production of dust due to demolition operations. Do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- E. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

3.03 EXISTING UTILITIES

- A. Coordinate work with utility companies. Notify utilities before starting work, comply with their requirements, and obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.
- H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone. Identify and mark, in same manner as other utilities to remain, utilities to be reconnected.

3.04 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Existing construction and utilities indicated on drawings are based on casual field observation and existing record documents only.
 - 1. Verify construction and utility arrangements are as indicated.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Remove existing work as indicated and required to accomplish new work.
 - 1. Remove items indicated on drawings.
- C. Services including, but not limited to, Electrical and Telecommunications: Remove existing systems and equipment as indicated.
 - 1. Maintain existing active systems to remain in operation, and maintain access to equipment and operational components.
 - 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - 3. See Section 01 1000 Summary for limitations on outages and required notifications.
 - 4. Verify that abandoned services serve only abandoned facilities before removal.
 - 5. Remove abandoned pipe, ducts, conduits, and equipment. Remove back to source of supply where possible, otherwise cap stub and tag with identification.
- D. Protect existing work to remain.
 - 1. Prevent movement of structure. Provide shoring and bracing as required.
 - 2. Perform cutting to accomplish removal work neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
 - 4. Patch to match new work.

3.05 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

SECTION 03 1000 CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Formwork for cast-in place concrete, with shoring, bracing and anchorage.
- B. Openings for other work.
- C. Form accessories.
- D. Form stripping.
- E. Waterstops
- F. Placement of anchor bolts, embed plates, and anchorages

1.02 RELATED REQUIREMENTS

- A. Section 03 2000 Concrete Reinforcing.
- B. Section 03 3000 Cast-in-Place Concrete.
- C. Section 03 3500 Concrete Floor Finishes: Specially surfaced concrete.
- D. Section 03 3543 Polished Concrete Finishing: Finishing for new concrete slabs
- E. Section 05 1200 Structural Steel Framing: Anchor bolts for Structural Steel.
- F. Section 05 5000 Metal Fabrications: Anchor Bolts for Metal Fabrications and other trades.
- G. Section 06 1000 Rough Carpentry: Anchor bolts for Rough Carpentry.
- H. Section 07 2100 Thermal Insulation: Underslab insulation.
- I. Section 31 6614 Hydraulically Driven Pier Foundations: Shoring and underpinning related to hydraulically driven piles.

1.03 REFERENCE STANDARDS

- A. ACI 117 Specification for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).
- B. ACI 301 Specifications for Concrete Construction; 2020.
- C. AISC S303 Code of Standard Practice for Steel Buildings and Bridges; American Institute of Steel Construction, Inc.; 2000.
- D. OSSC Oregon Structural Specialty Code, latest edition.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on void form materials and installation requirements.
- C. Shop Drawings: Indicate pertinent dimensions, materials, bracing, and arrangement of joints and ties.

PART 2 PRODUCTS

2.01 FORMWORK - GENERAL

- A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.
- B. Design and construct concrete that complies with design with respect to shape, lines, and dimensions.
- C. Chamfer outside corners of beams, joists, columns, and walls unless otherwise indicated on Drawings.
- D. Formwork design and engineering are Contractor's responsibility. Comply with applicable state and local codes with respect to design, fabrication, erection, and removal of formwork.

2.02 WOOD FORM MATERIALS

A. Form Materials:

- 1. At exposed vertical surfaces: MDO plywood, smooth and free of any surface texture.
- 2. At other locations: Contractor discretion in accordance with ACI 347.

2.03 FORMWORK ACCESSORIES

- A. Form Ties: Removable type, galvanized metal, fixed length, cone type, with waterproofing washer, one inch back break dimension, free of defects that could leave holes larger than 1 inch in concrete surface.
- B. Form Release Agent: Capable of releasing forms from hardened concrete without staining or discoloring concrete or forming bugholes and other surface defects, compatible with concrete and form materials, and not requiring removal for satisfactory bonding of coatings to be applied.
 1. Composition: Colorless, reactive, water-based or solvent-based compound.
 - 1. Composition: Coloriess, reactive, water-based or solvent-based compound.
- C. Reveal / Chamfer Strips: Rigid plastic or wood strip type; 3/4 x 3/4 inch size unless otherwise noted on Drawings; maximum possible lengths. Mill wood strips from straight-grained lumber and surface all sides.
- D. Embedded Anchor Shapes, Plates, Angles and Bars: As specified in Section 05 1200.
- E. Lightweight concrete formwork: Expanded polystyrene; Styrofoam, or equivalent.
- F. Waterstops: Expandable Bentonite type. 1 inch wide by 1/2 inch thick (dry), strips of maximum possible lengths, moisture expanding. Provide Superstop manufactured by Tremco, or approved.
 - 1. Extent: At all cold joints below grade, and elsewhere as shown on drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.
- B. Verify subgrade is at proper depth to accommodate footing and slab thickness.

3.02 EARTH FORMS

A. Earth forms are not permitted.

3.03 ERECTION - FORMWORK

- A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.
- B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.
- C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- D. Align joints and make watertight. Keep form joints to a minimum.
- E. Unless otherwise indicated, install form ties equidistant and symmetrical, aligned vertically and horizontally
- F. Obtain approval before framing openings in structural members that are not indicated on drawings.
- G. Provide chamfer strips at the following locations:
 - 1. External corners.
 - 2. Locations indicated on Drawings.
- H. Coordinate this section with other sections of work that require attachment of components to formwork.
- I. If formwork is placed after reinforcement, resulting in insufficient concrete cover over reinforcement, request instructions from Architect before proceeding.

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3.04 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

3.05 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Provide formed openings where required for items to be embedded in or passing through concrete work.
- B. Locate and set in place items that will be cast directly into concrete. Do not 'wet set'.
- C. Place anchor bolts in accordance with AISC Code of Standard Practice.
- D. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.
- E. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- F. Install waterstops in accordance with manufacturer's instructions, so they are continuous without displacing reinforcement. Ensure that minimum coverage is provided from waterstop to face of concrete.
- G. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- H. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.06 FORM CLEANING

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.

3.07 FORMWORK TOLERANCES

A. Construct formwork to maintain tolerances required by ACI 117, unless otherwise indicated.

3.08 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
- B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.

3.09 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
- B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

SECTION 03 2000 CONCRETE REINFORCING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Reinforcing steel for cast-in-place concrete.
- B. Supports and accessories for steel reinforcement.

1.02 RELATED REQUIREMENTS

- A. Section 03 1000 Concrete Forming and Accessories.
- B. Section 03 3000 Cast-in-Place Concrete.
- C. Section 04 2000 Unit Masonry: Reinforcement for masonry.

1.03 REFERENCE STANDARDS

- A. ACI 301 Specifications for Concrete Construction; 2020.
- B. ACI 318 Building Code Requirements for Structural Concrete; 2019, with Errata (2021).
- C. ACI SP-66 ACI Detailing Manual; 2004.
- D. ASTM A615/A615M Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2020.
- E. ASTM A706/A706M Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement; 2022.
- F. ASTM A1064/A1064M Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2018a.
- G. AWS B2.1/B2.1M Specification for Welding Procedure and Performance Qualification; 2021.
- H. CRSI (DA4) Manual of Standard Practice; 2009.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Comply with requirements of ACI SP-66. Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.
- C. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301.
- B. Provide 48 hours notice to Architect for review of completed reinforcement. Allow 24 hours for Architect's review. Allow sufficient time in construction schedule for corrections to reinforcement prior to placement of concrete.

PART 2 PRODUCTS

2.01 REINFORCEMENT

- A. Reinforcement Steel: As indicated on Drawings.
- B. Reinforcing Steel, weldable: All reinforcing steel to be welded or bent in the feild, and as indicated on Structural drawings; ASTM A706/A706M, Grade 60, deformed billet-steel bars, unfinished.
- C. Plain Steel Welded Wire Reinforcement (WWR): ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets
 - 1. Mesh Size and Wire Guage: As indicated on the Drawings.
- D. Reinforcing Steel: ASTM A706/A706M, deformed low-alloy steel bars.
- E. Reinforcement Accessories:

- 1. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch.
- 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
- 3. Provide stainless steel, galvanized, plastic, or plastic coated steel components for placement within 1-1/2 inches of weathering surfaces.

2.02 FABRICATION

- A. Fabricate concrete reinforcing in accordance with CRSI (DA4) Manual of Standard Practice.
- B. Welding of reinforcement is not permitted unless shown on Drawings.
- C. Locate reinforcing splices not indicated on drawings at point of minimum stress.

PART 3 EXECUTION

3.01 PLACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position.
- B. Comply with applicable code for concrete cover over reinforcement.

3.02 FIELD QUALITY CONTROL

A. An independent testing agency, as specified in Section 01 4000 - Quality Requirements, will inspect installed reinforcement for compliance with contract documents before concrete placement.

SECTION 03 3000 CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Footings, stem walls, and slabs on grade.
- B. Site walls and seating walls.
- C. Concrete elevator pit walls and slab.
- D. Joint devices associated with concrete work.
- E. Miscellaneous concrete elements, including equipment pads, equipment pits, light pole bases, flagpole bases, thrust blocks, and manholes.
- F. Concrete curing.
- G. Underslab vapor barriers.

1.02 RELATED REQUIREMENTS

- A. Section 03 1000 Concrete Forming and Accessories: Forms and accessories for formwork; placement of anchors and embeds.
- B. Section 03 2000 Concrete Reinforcing.
- C. Section 03 3511 Concrete Floor Finishes: Densifiers, hardeners, applied coatings.
- D. Section 03 3543 Polished Concrete Finishing: Polishing and finishing of concrete surfaces.
- E. Section 05 12 00 Structural Steel: Grouting under base plates.
- F. Section 07 9200 Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.
- G. Section 32 1313 Concrete Paving: Sidewalks, curbs and gutters.

1.03 REFERENCE STANDARDS

- A. ACI 211.1 Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).
- B. ACI 301 Specifications for Concrete Construction; 2020.
- C. ACI 302.1R Guide to Concrete Floor and Slab Construction; 2015.
- D. ACI 304R Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).
- E. ACI 305R Guide to Hot Weather Concreting; 2010.
- F. ACI 306R Guide to Cold Weather Concreting; 2016.
- G. ACI 308R Guide to External Curing of Concrete; 2016.
- H. ACI 318 Building Code Requirements for Structural Concrete; 2019, with Errata (2021).
- I. ASTM C33/C33M Standard Specification for Concrete Aggregates; 2018.
- J. ASTM C39/C39M Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2020.
- K. ASTM C94/C94M Standard Specification for Ready-Mixed Concrete; 2020.
- L. ASTM C150/C150M Standard Specification for Portland Cement; 2021.
- M. ASTM C260/C260M Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).
- N. ASTM C494/C494M Standard Specification for Chemical Admixtures for Concrete; 2019.
- O. ASTM C618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2019.

- P. ASTM C1602/C1602M Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2012.
- Q. ASTM D1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 2018.
- R. ASTM E1155 Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers; 2014.
- S. ASTM E1745 Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017.
- T. NSF 61 Drinking Water System Components Health Effects; 2021.
- U. NSF 372 Drinking Water System Components Lead Content; 2022.
- V. OSSC Oregon Structural Specialty Code, latest edition.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
- C. Mix Design: Submit proposed concrete mix design.
 - 1. Indicate proposed mix design complies with requirements of ACI 318, Chapter 5 Concrete Quality, Mixing and Placing, and requirements of the OSSC.
- D. Samples: Submit samples of underslab vapor retarder to be used.
- E. Test Reports: Submit report for each test or series of tests specified.
- F. Slab Jointing Plan: Show location of slab control joints, closure panels, and slab construction joints not shown on Drawings.
- G. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301 and ACI 318.
- B. Follow recommendations of ACI 305R when concreting during hot weather.
- C. Follow recommendations of ACI 306R when concreting during cold weather.

1.06 MOCK-UP

- A. Construct and erect mock-up wall panel for architectural concrete surfaces indicated to receive special treatment or finish such as sandblast finish:
 - 1. Panel Size: 6 by 6 feet.
 - 2. Number of Panels: One.
 - 3. Architect to review proposed location..
- B. Coordinate with Work of Section 03 3543 Polished Concrete Finishing for casting slabs for mock-ups of polished concrete flooring.
- C. Accepted mock-up panel is considered basis of quality for the finished work. Keep mock-up exposed to view for duration of concrete work.
- D. Mock-up may not remain as part of the Work.

PART 2 PRODUCTS

2.01 FORMWORK

A. Comply with requirements of Section 03 1000.

2.02 REINFORCEMENT MATERIALS

A. Comply with requirements of Section 03 2000.

2.03 CONCRETE MATERIALS

- A. Cement: ASTM C150, Type I Normal, or Type II Moderate Portland type.
- B. Fine and Coarse Aggregates: ASTM C33/C33M.
- C. Fly Ash: ASTM C618, Class C or F.
- D. Slag: Ground Granulated Blast-Furnace Slag; ASTM C989, Grade 100 or 120.
- E. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

2.04 ADMIXTURES

- A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement. Calcium chloride is not allowed.
- B. Air Entrainment Admixture: ASTM C260/C260M.
- C. High Range Water Reducing and Retarding Admixture: ASTM C494/C494M Type G.
- D. High Range Water Reducing Admixture: ASTM C494/C494M Type F.
- E. Water Reducing Admixture: ASTM C494/C494M Type A.

2.05 ACCESSORY MATERIALS

- A. Underslab Vapor Retarder: Multi-layer, fabric-, cord-, grid-, or aluminum-reinforced polyethylene or equivalent, complying with ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs; 15 mils thickness, maximum perm rating of 0.01. The use of single ply polyethylene is prohibited.
 - 1. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.
 - 2. Manufacturers:
 - a. Stego Industries, LLC; ____: www.stegoindustries.com.
 - b. W. R. Meadows, Inc; PERMINATOR Class A 15 mils (0.38 mm): www.wrmeadows.com/#sle.
 - c. Raven Industries; VaporBlock 15: www.ravenind.com.
 - d. Substitutions: See Section 01 6000 Product Requirements.
 - 3. Extent of Use: Under all interior slabs-on-grade, unless otherwise noted.
- B. Screw Anchors for Concrete and Masonry: Carbon steel, heat treated, since plated Heavy duty screw anchor. Use where shown on drawings. Simpson Strong-Tie Titen HD, Power's Wedge-Bolt, or approved.

2.06 BONDING AND JOINTING PRODUCTS

- A. Waterstops: Bentonite and butyl rubber, complying with NSF 61 and NSF 372.
 - 1. Configuration: As indicated on drawings.
 - 2. Manufacturers:
 - a. CETCO, a division of Minerals Technologies Inc; WATERSTOP RX: www.mineralstech.com.
 - b. The Penetron Group; Penebar SW-55: www.penetron.com.
 - c. Substitutions: See Section 01 6000 Product Requirements.
- B. Exterior Slab Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.
 - 1. Material: ASTM D1751, cellulose fiber.
- C. Interior Slab Isolation Joint Filler: 1/4 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.
 1. Material: ASTM D1752, sponge rubber (Type I).
- D. Slab Construction Joint Devices: Combination keyed joint form and screed, galvanized steel, with rectangular or round knockout holes for conduit or rebar to pass through joint form at 6 inches on center; ribbed steel stakes for setting

E. Dowel Sleeves: Plastic sleeve and nailable plastic base for smooth, round, steel load-transfer dowels

2.07 CURING MATERIALS

- A. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound, that dissipates within 3 to 5 weeks; complying with ASTM C309, Type 1.
 1. Ensure compatibility with Hardeners, Sealers, or Coatings specified in Section 03 3511.
- B. Water: Potable, not detrimental to concrete.

2.08 CONCRETE MIX DESIGN

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
 - 1. Replace as much Portland cement as possible with fly ash, ground granulated blast furnace slag, silica fume, or rice hull ash as is consistent with ACI recommendations.
- B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
 - 1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.
 - 2. Supplier is responsible for achieving or exceeding concrete design strengths.
- C. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.
 - 1. Use accelerating admixtures in cold weather only when approved by Architect. Use of admixtures will not relax cold weather placement requirements.
 - 2. Use set retarding admixtures during hot weather only when approved by Architect.
- D. Add air entraining agent to normal weight concrete mix for horizontal work exposed to exterior.
- E. Normal Weight Concrete:
 - 1. At Footings: As indicated on Structural Drawings.
 - 2. At Building Slabs-on-Grade: As indicated on Structural Drawings

2.09 MIXING

- A. Transit Mixers: Comply with ASTM C94/C94M.
- B. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

- A. Verify that forms are clean and free of rust before applying release agent.
- B. Verify that Surfaces to receive Vapor Barrier are clean, solid, free of projections and otherwise properly prepared.
- C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
- D. Vapor Barrier at Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.

3.03 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304R.
- B. Place concrete for floor slabs in accordance with ACI 302.1R.

- C. Notify Architect not less than 48 hours prior to commencement of placement operations.
- D. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
- E. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.
- F. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

3.04 SLAB JOINTING

- A. Locate joints as indicated on Slab Jointing Plan appoved through shop drawing submittal review process.
- B. Anchor joint fillers and devices to prevent movement during concrete placement.
- C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
 - 1. Install where indicated on drawings, and wherever necessary to separate slab from other building members, including columns, walls, equipment foundations, footings, stairs, manholes, sumps, and drains.
- D. Load Transfer Construction and Contraction Joints: Install load transfer devices as indicated; saw cut joint at surface as indicated for contraction joints.
- E. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch thick blade and cut at least 1-1/2 inch deep but not less than one quarter (1/4) the depth of the slab.

3.05 FLOOR FLATNESS AND LEVELNESS TOLERANCES

- A. Maximum Variation of Surface Flatness:
 - 1. Exposed Concrete Floors: 1/4 inch in 10 feet.
 - 2. Under Seamless Resilient Flooring: 1/4 inch in 10 feet.
 - 3. Under Carpeting: 1/4 inch in 10 feet.
- B. Correct the slab surface if tolerances are other than specified.
- C. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified by the Architect. Re-measure corrected areas by the same process.

3.06 CONCRETE FINISHING

- A. Repair surface defects, including tie holes, immediately after removing formwork.
- B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.
- C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:
 - 1. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.
- D. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1:100 nominal.
- E. Concrete Polishing: See Section 03 3511.
- F. Exterior Concrete Walks & Slabs: Broom finish unless otherwise noted.

3.07 CURING AND PROTECTION

A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- C. Surfaces Not in Contact with Forms:
 - 1. Slabs and Floors To Receive Adhesive-Applied Flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, either obtain the approval of the flooring and adhesive manufacturers prior to use or remove the surface coating after curing to flooring manufacturer's satisfaction.
 - 2. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-fog spray, or saturated burlap.
 - a. Ponding: Maintain 100 percent coverage of water over floor slab areas, continuously for 7 days.
 - b. Spraying: Spray water over floor slab areas and maintain wet.
 - c. Saturated Burlap: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place.
 - 3. Final Curing: Begin after initial curing but before surface is dry.
 - a. Curing Compound: Apply in two coats at right angles, using application rate recommended by manufacturer.

3.08 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
- B. An independent testing agency will perform Special Inspection for footings, as specified in Section 01400.
- C. Provide free access to concrete operations at project site and cooperate with appointed firm. Notify Architect and Testing Lab at least 48 hours before intended concrete placement.
- D. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
- E. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.
- F. Compressive Strength Tests: ASTM C39/C39M. For each test, mold and cure a set of five concrete test cylinders. Obtain test samples for every 150 cu yd or less of each class of concrete placed each day.
 - 1. Perform compressive strength tests on sets of cylinders at their respective age as follows:
 - a. One at seven days
 - b. One at 14 days
 - c. Two at 28 days, and
 - d. Hold one for future use
 - 2. If at the end of the project all of the concrete reaches the required compressive strength, the held cylinders may be discarded without being tested.
- G. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
- H. Perform one air content test for each set of cylinders taken for air-entrained concrete, following procedures of ASTM C173/C173M.

3.09 DEFECTIVE CONCRETE

- A. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.
- B. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

3.10 PROTECTION

A. Do not permit traffic over unprotected concrete floor surface until fully cured.

SECTION 03 3511 CONCRETE FLOOR FINISHES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface treatments for concrete floors and slabs.
- B. Liquid densifiers and hardeners.
- C. Sealer/hardener: SLR
- D. Moisture Mitigation Coating.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 Cast-in-Place Concrete: Finishing of concrete surface to tolerance; floating, troweling, and similar operations; curing.
- B. Section 03 3000 Cast-in-Place Concrete: Curing compounds that also function as sealers.
- C. Section 03 3543 Polished Concrete Finishing: surface treatments.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with concrete floor placement and concrete floor curing.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.
- C. Maintenance Data: Provide data on maintenance and renewal of applied finishes.

1.05 MOCK-UP

- A. For coatings, construct mock-up area under conditions similar to those that will exist during application, with coatings applied.
- B. Mock-Up Size: 10 feet square.
- C. Locate where directed.
- D. Mock-up may remain as part of the work.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's sealed packaging, including application instructions.

PART 2 PRODUCTS

2.01 CONCRETE FLOOR FINISH APPLICATIONS

- A. Liquid Densifier and Hardener:
 - 1. Use where Finish Schedule indicates "Hardener."

2.02 DENSIFIERS AND HARDENERS

- A. Liquid Densifier and Hardener: Penetrating chemical compound that reacts with concrete, filling the pores and dustproofing; for application to concrete after set.
 - 1. Composition: Sodium silicate. Odorless, colorless, waterborne solution, compliant with project's VOC requirements.
 - 2. Products:
 - a. Ardex Engineered Cements; www.ardexamericas.com.
 - b. Curecrete Distribution, Inc.; Ashford Formula: www.ashfordformula.com.
 - c. Dayton Superior Corporation; _____: www.daytonsuperior.com/#sle.

- d. Master Builders Solutions by BASF; Kure-N-Harden: www.master-builders-solutions.basf.us/en-us/#sle.
- e. Euclid Chemical Company; Diamond Hard: www.euclidchemical.com.
- f. L&M Construction Chemicals, Inc; Seal-Hard: www.Imcc.com.
- g. Nox-Crete; Duro-nox.
- h. Vexcon Chemical; Starseal PS Clear.
- i. W. R. Meadows, Inc; Liqui-Hard: www.wrmeadows.com/#sle.
- j. Substitutions: See Section 01 6000 Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that floor surfaces are acceptable to receive the work of this section.
- B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

3.02 GENERAL

A. Apply materials in accordance with manufacturer's instructions.

SECTION 03 3543 POLISHED CONCRETE FINISHING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Polished concrete finishing, including sealer and densifiers indicated as POL. See finish legend on drawings.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 Cast-In-Place Concrete.
- B. Section 03 3511 Concrete Floor Finishes
- C. Section 07 9005 Joint Sealers.

1.03 REFERENCE STANDARDS

- A. ASTM C501 Standard Test Method for Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser.
- B. ASTM C779/C779M Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces.
- C. ASTM D523 Standard Test Method for Specular Gloss.
- D. National Floor Safety Institute (NFSI) NFSI Test Method 101-A Standard for Evaluating High-Traction Flooring Materials, Coatings, and Finishes.

1.04 PERFORMANCE DESCRIPTION

- A. Performance Criteria:
 - 1. Abrasion Resistance: ASTM C779, Method A, high resistance, no more than 0.008 inch wear in 30 minutes, or ASTM C501.
 - 2. Reflectivity: Minimum average 60 when tested in accordance with ASTM D523 by standard gloss meter.
 - 3. High Traction Rating: NFSI 101-A non-slip properties.

1.05 SUBMITTALS

- A. See Section 01 3300 Administrative Requirements, for submittal procedures.
- B. Product Data:
 - 1. Submit special concrete finishes manufacturer's specifications, test data and other data required for each type of manufactured material and product indicated.
 - 2. Submit special concrete finishes describing product to be provided, giving manufacturer's name and product name for the specified material proposed to be provided under this section.
 - 3. Submit special concrete finishes technical data sheet giving descriptive data, curing time, and application requirements.
- C. Installation Instructions: Submit manufacturer's installation instructions for all special concrete finishes.
- D. Submit a plan on how the finished concrete slab will be protected from the time of completion of the finish work through to substantial completion of the project.
- E. Certificates:
 - 1. Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
 - 2. Letter of certification from the National Floor Safety Institute confirming the system has been tested and passed Phase Two Level of certification when tested by Method 101-A.
 - 3. Provide letter of certification from concrete finish manufacturer stating that installer is certified applicator of specified concrete finishes, and is familiar with proper procedures and installation requirements required by the manufacturer.

- F. Maintenance Data:
 - 1. Manufacturer's maintenance procedures, recommended maintenance materials and suggested schedule for cleaning.
 - 2. Protocols and product specifications for joint filling, crack repair and surface repair.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Use a certified, factory trained installer and adequate number of skilled workmen who are thoroughly trained and experienced in the necessary craft.
 - 2. Applicator shall be approved by polished concrete finish manufacturer.
 - 3. Applicator shall be familiar with the specified requirements and the methods needed for proper performance of work of this section. Applicator must have availability of proper equipment and manpower to perform work within scope of this project on a timely basis during normal daytime working hours or must include in their bid the cost of all overtime required by the Contractor to supervise the additional hours of work.
 - 4. The installer must have performed a minimum of five projects of 5000 square feet or greater with concrete polishing/ dye/hardener-sealer combination.

1.07 PREINSTALLATION CONFERENCE

- A. Pre-Installation Conference: Conduct conference at project site to comply with requirements of Section 01 30 00 - Administrative Requirements. Owner, Architect, Contractor, Installer, Product Manufacturer and Equipment Manufacturer are to be in attendance. Review the following, as a minimum:
 - 1. Polisher shall demonstrate understanding of work required by reviewing and discussing procedures for, but not limited to, following:
 - a. Tour areas to be polished and discuss and evaluate substrate conditions, surface preparation, sequence procedures and other preparatory work.
 - b. Review Contract Document requirements.
 - c. Status of submittal review.
 - d. Environmental requirements.
 - e. Scheduling and phasing of work.
 - f. Coordinating with other work and personnel.
 - g. Protection of adjacent surfaces.
 - h. Surface preparation.
 - i. Dust control.
 - j. Repair of defects and defective work prior to installation.
 - k. Mock-up review and acceptance.
 - I. Cleaning.
 - m. Installation of polished floor finishes, including procedural steps of grinding, honing and polishing operations.
 - n. Application of liquid hardener, densifier.
 - o. Installation of joint sealants.
 - p. Protection of floor surfaces prior to polishing or application of dye.
 - q. Protection of finished surfaces after installation.

1.08 MOCK-UP

- A. Provide mock-up of finish 5 foot by 5 foot in location directed by Architect.
- B. Install mock-up to demonstrate typical joints, surface finish, color variation and standard of workmanship. Include sealers in mock-ups.
 - 1. Mock-up shall also demonstrate dust control measures.
- C. Notify Architect seven days in advance of dates and times when mock-ups will be constructed.
- D. Obtain Architect's approval of mock-ups before starting actual installation.
- E. If Architect determines that mock-ups do not meet requirements, demolish and remove them from the site and prepare others until mock-ups are accepted.

- F. Maintain mock-ups during construction exposed to view in an undisturbed condition as a standard for judging the completed work. Protect from weather.
- G. Mock-up may remain as part of the Work.

1.09 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original containers, with seals unbroken, bearing manufacturer labels indicating brand name and directions for storage.
- B. Dispense special concrete finish material from factory numbered and sealed containers. Maintain record of container numbers.

1.10 PROJECT CONDITIONS

- A. Environmental limitations: Comply with manufacturers written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting topping performance.
 - 1. Verify that concrete meets minimum F(F) Floor Flatness and F(L)F Floor Levelness specified in Section 03 30 00 Cast-in-Place Concrete.
 - 2. Concrete must be cured a minimum of 28 days or as directed by the manufacturer before application can begin.
- B. Close areas to traffic during and after application, for time period recommended in writing by manufacturer.
- C. Slab Protection:
 - 1. Protect slab in advance of Floor Finishing Work from damage that would stair or mar concrete.
 - 2. Diaper all hydraulic powered equipment to avoid staining of the concrete.
 - 3. Do not permit any trade to park vehicles on the floor slab. If necessary to complete their scope of work, place drop cloths under vehicles at all times.
 - 4. No pipe cutting machines are to be used on the floor slab.
 - 5. Do not place steel on floor slab to avoid rust staining.
 - 6. Equip all equipment with non-marking tires.
 - 7. Do not allow the use of tape on polished or dyed floors.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers:
 - 1. L&M Construction Chemicals, Inc: www.Imcc.com.
 - 2. Lythic Solutions, Inc: www.lythic.com.
 - 3. Consolideck System by Prosoco: www.prosoco.com.
 - 4. RetroPlate: www.retroplatesystems.com.
 - 5. Substitutions: See Section 01 60 00 Product Requirements.

2.02 MATERIALS

- A. . Polished Concrete System: Materials, equipment, and procedures designed by one manufacturer to produce dense polished concrete of the specified sheen, consistent from wall to wall.
- B. Approved polished concrete systems:
 - . L&M Construction Chemicals System:
 - a. Hardening/Sealing/Densifier Agent: Proprietary, water-based, odorless liquid, VOC compliant, environmentally safe chemical hardening solution leaving no surface film.
 - 1) Product: L&M Construction Chemicals, Inc., FGS Hardener Plus.
 - b. Joint Filler: Semi-rigid, 2-component, self-leveling, 100% solids, rapid curing polyurea control joint and crack filler with Shore A 75 or higher hardness.
 - 1) Product: As specified in Section 07 9005 Joint Sealers.

- c. Floor Sealer in Toilet Rooms 114, 115, 116, 117, 150 & 151 and Break Room 152: Ready to use, silane, siloxane and fluoropolymers blended water based solution sealer, quick drying, low-odor, oil and water repellent, VOC compliant and compatible with chemically hardened floors.
 - 1) Product: L&M Construction Chemicals, Inc., Permaguard SPS.
- d. Floor Sealer all Other Areas: Penetrating concrete sealer recommended by densifier manufacturer.
- e. Cleaning Solution: Proprietary, mild, highly concentrated liquid concrete cleaner and conditioner containing wetting and emulsifying agents; biodegradable, environmentally safe and certified High Traction by National Floor Safety Institute (NFSI):
 - 1) Product: L&M Construction Chemicals, Inc. FGS Concrete Conditioner.
- 2. Lythic Solutions System:
 - a. Hardening/Sealing/Densifier Agent: Colloidal silica based concrete hardener and densifier.
 - 1) Product: Lythic Densifier.
 - b. Joint Filler: Semi-rigid, 2-component, self-leveling, 100% solids, rapid curing polyurea control joint and crack filler with Shore A 75 or higher hardness.
 - 1) Product: As specified in Section 07 9005 Joint Sealers.
 - c. Floor Sealer in Toilet Rooms 114, 115, 116, 117, 150 & 151 and Break Room 152: Micro film forming sealer.
 - 1) Product: Lythic SPD Protector.
 - d. Floor Sealer all Other Areas: Penetrating concrete sealer recommended by densifier manufacturer.
 - 1) Product: Lythic Protector.
 - e. Cleaning Solution: Non-corrosive cleaner recommended by densifier manufacturer.
 - 1) Product: Lythic Cleaner.
- 3. Consolideck System:
 - a. Hardening/Sealing/Densifier Agent: Water-based lithium silicate concrete hardener and densifier.
 - 1) Product: Consolideck LS.
 - b. Joint Filler: Semi-rigid, 2-component, self-leveling, 100% solids, rapid curing polyurea control joint and crack filler with Shore A 75 or higher hardness.
 - 1) Product: As specified in Section 07 9005 Joint Sealers.
 - c. Floor Sealer in Break Room 152: Micro film forming sealer.
 - 1) Product: Consolideck LS GUARD diluted 1:1 with potable water applied in two coats at 2000 to 3000 sq ft/gal. High speed burnish each coat to 90.5 degree F.
 - d. Floor Sealer in Toilet Rooms 114, 115, 116, 117, 150 & 151: Micro film forming sealer.
 - Product: Consolideck PolishGuard undiluted applied with manufacturer's recommended sprayer in two coats at 400 to 800 sq ft/gal. High speed burnish final coat. Note: Consolideck has a different product that needs to be used at toilet rooms.
 - e. Floor Sealer all Other Areas: Penetrating concrete sealer recommended by densifier manufacturer for repelling water-based and oil-based stains.
 1) Product: Consolideck SLX 100.
 - f. Cleaning Solution: Non-corrosive cleaner recommended by densifier manufacturer.
 1) Product: Consolideck LSKlean.
- 4. Retroplate System:
 - a. Hardening/Sealing/Densifier Agent: Water-based silicate concrete hardener and densifier.
 - 1) Product: Retroplate 99 Densifier.
 - b. Joint Filler: Semi-rigid, 2-component, self-leveling, 100% solids, rapid curing polyurea control joint and crack filler with Shore A 75 or higher hardness.

- 1) Product: As specified in Section 07 9005 Joint Sealers or CureCrete Cretefill Pro 75.
- c. Floor Sealer in Toilet Rooms 114, 115, 116, 117, 150 & 151 and Break Room 152: Water-based silicate and polymeric component copolymer.
 - 1) Product: RetroGuard diluted 1:1 with potable water applied in two 3000 sq. ft./gal. coats. Buff after each coat.
- d. Floor Sealer all Other Areas: Penetrating concrete sealer recommended by densifier manufacturer.
- e. Cleaning Solution: Non-corrosive cleaner recommended by densifier manufacturer.
 1) Product: CreteClean Plus.

2.03 ACCESSORIES

- A. Joint Filler: Semi-rigid, 2-component, self-leveling, 100% solids, rapid curing polyurea control joint and crack filler with Shore hardness of A90-95 or higher hardness.
 - 1. Product: Uzin "MM-80"
 - 2. Substitutions: See Section 01 6000 Product Requirement
 - 3. Color: Selected by Architect from manufacturer's full color line
- B. Patching Compound: Compound composed of 40 percent Portland cement, 45 percent limestone and 15 percent vinyl acetate copolymer, when mixed with dust salvaged from grinding process forms a paste that hardens when surface imperfections are filled.
- C. Grout Material: Clear modified silicate sealant, containing no pore clogging latex, when mixed with dust salvaged from grinding process forms a paste that reacts with calcium hydroxide in concrete that hardens when surface imperfections are filled.
 - 1. Available Product: Versaflex QuickMender or approved equal.
- D. Polishing Equipment: As required by installer to achieve specified aesthetic finish and gloss meter reading.
 - 1. Use dust extraction equipment with a flow rate suitable for dust generated by polishing installer's equipment.
- E. Temporary Protection of Finished Floors:
 - 1. L. M. Scofield ProGuard Duracover
 - 2. Ram Board Heavy Duty Floor Protection
 - 3. Substitutions: See Section 01 6000 Product Requirements.
 - 4. Seaming of the temporary floor protection will be performed with floor protection board manufacturer's Heavy Duty Seaming Tape

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

- A. Examine substrate, with installer present, for conditions affecting performance of finish. Correct conditions detrimental to timely and proper work. Do not proceed until unsatisfactory conditions are corrected.
- B. New Slabs:
 - 1. Verify that slab has cured in accordance with manufacturer's requirements.
 - 2. Verify that the floor surfaces are free of construction latents.
 - 3. Verify that concrete surfaces received a hard steel-trowel finish or plastic trowel finish (3 passes) during placement as specified in section 03 3000 Cast-in-Place Concrete.
 - 4. Remove any existing surface contamination that may be detrimental to finish.
 - 5. Verify that slab meets finish and surface profile requirements specified in Section 03 30 00 Cast-In-Place Concrete.
- C. Mask and tape off all air supply/return duct diffusers and dampers, light fixtures, smoke alarms, technology closets, etc. to ensure that polishing dust does not spread into and contaminate these areas/devices. Cover open shelving/bookcases, cabinet drawers/doors, etc. Mock-up first area to be polished to demonstrate dust control measures.

3.02 INSTALLATION

- A. Protect adjacent areas from damage due to polishing, dying and sealing activities.
- B. Start any of the floor finish applications in presence of manufacturer's technical representative.
- C. Do not commence polishing until concrete has cured a minimum of 28 days, unless otherwise accepted by manufacturer.
- D. Floor Surface Polishing and Treatment:
 - 1. Provide polished concrete floor treatment in entirety of slab indicated by Drawings. Provide consistent finish in all contiguous areas.
 - 2. Finish to within 1/8 inch of vertical surfaces.
 - 3. Apply floor finish prior to installation of fixtures and accessories.
 - 4. Diamond polish concrete floor surfaces in accordance with the following requirements:
 - a. Expose fine aggregates for a salt and pepper finish.
 - b. Polish floor surfaces to an average minimum gloss meter reading of 80 high gloss (typically 1500 grit)
 - 1) Polish slabs adjacent to entrances where indicated to meet slip-resistance requirements (200 grit).
 - 2) Gloss meter testing may be performed by Owner prior to any application of a sealer. The first test in any area will be paid for by the Owner. If the first test fails in that area, all subsequent tests in that area will be at the expense of the polishing installer.
 - c. Comply with manufacturer's recommended polishing grits for each sequence to achieve desired finish level. Level of sheen shall match that of approved mock-up.
 - d. Expose aggregate in concrete surface only as determined by approved mock-up.
 - 5. Hardener/Densifier Application: Apply densifier in strict accordance with manufacturer's recommendations.
 - a. Follow manufacturer's recommendations for drying time between successive coats.
 - 6. Sealer Application: Apply two coats of sealer in accordance with manufacturer's published recommendations.
 - 7. Remove defects and repolish defective areas.
 - 8. Finish edges of floor finish adjoining other materials in a clean and sharp manner.

3.03 ADJUSTMENTS

- A. Polish to higher gloss those areas not meeting specified gloss levels per mock-up.
- B. Fill joints flush to surface.
- C. Mechanically scrub treated floors for seven days with soft to medium pads with approved cleaning solution.

3.04 CLEANING:

- A. Keep premises clean and free of debris at all times.
- B. Remove spatter from adjoining surfaces, as necessary.
- C. Repair damages to surface caused by cleaning operations.
- D. Remove debris from jobsite. Dispose of materials in separate, closed containers in accordance with local regulations.

3.05 PROTECTION:

- A. Final Protection: Following completion of final polishing, cover surfaces to protect from ongoing construction operations until Substantial Completion. Cover with breathable product such as kraft paper or thin curing blanket. Do not cover with masonite, plywood or polyethylene sheets.
 - 1. Do not tape protection to finished floor surfaces.

SECTION 03 41 00 PRECAST STRUCTURAL CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Plant Cast Structural Wall Panels
- B. Beams, spandrels, girders, purlins.
- C. Floor double tees and channel slabs.
- D. Grout packing.
- E. Connection and supporting devices.
- F. Lintels and bond beams.

1.02 REFERENCE STANDARDS

- A. ACI 318 Building Code Requirements for Structural Concrete and Commentary; 2011.
- B. ASTM A36/A36M Standard Specification for Carbon Structural Steel; 2014.
- C. ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- D. ASTM A416/A416M Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete; 2012a.
- E. ASTM A615/A615M Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2015.
- F. ASTM A1064/A1064M Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2015.
- G. ASTM C150/C150M Standard Specification for Portland Cement; 2015.
- H. ASTM D3963/D3963M Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Reinforcing Steel Bars; 2001 (Reapproved 2007).
- I. AWS D1.1/D1.1M Structural Welding Code Steel; 2015.
- J. AWS D1.4/D1.4M Structural Welding Code Reinforcing Steel; 2011.
- K. PCI MNL-116 Manual for Quality Control for Plants and Production of Structural Precast Concrete Products; 1999, Fourth Edition.
- L. PCI MNL-120 PCI Design Handbook Precast and Prestressed Concrete; 2010, Seventh Edition.
- M. PCI MNL-123 Design and Typical Details of Connections for Precast and Prestressed Concrete; 1988, Second Edition.
- N. PCI MNL-135 Tolerance Manual for Precast and Prestressed Concrete Construction; 2000.

1.03 DESIGN REQUIREMENTS

- A. Conform to ACI 318 and applicable code for design load and construction requirements applicable to work of this section.
- B. Design components to withstand dead loads and design loads in the configuration indicated on the drawings.
 - 1. Calculate structural properties of framing members in accordance with ACI 318.
- C. Design members exposed to the weather to provide for movement of components without damage, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to seasonal or cyclic day/night temperature ranges.
- D. Design system to accommodate construction tolerances, deflection of other building structural members and clearances of intended openings.
- E. Submit reviewed shop drawings and design data to authorities having jurisdiction for approval.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a pre-installation conference one week prior to commencing work of this section.

1.05 SUBMITTALS

- A. See Section 03 33 00 -Submittal Procedures
- B. Product Data: Indicate standard component configurations, design loads, deflections, cambers, and bearing requirements.
- C. Shop Drawings: Indicate layout, unit locations, fabrication details, unit identification marks, reinforcement, integral insulation, insulated panel system connectors, connection details, support items, dimensions, openings, and relationship to adjacent materials. Indicate design loads, deflections, cambers, bearing requirements, and special conditions.
 - 1. Submit reviewed shop drawings and design data to authorities having jurisdiction for approval.
- D. Design Data: Submit design data reports indicating calculations for loadings and stresses of fabricated, designed framing.
- E. Welders' Certificates.
- F. Fabricator's Qualification Statement: Provide documentation showing precast concrete fabricator is accredited under IAS AC157.
- G. Design Data: Submit design data reports indicating calculations for loadings and stresses of fabricated, designed framing.

1.06 QUALITY ASSURANCE

- A. Designer Qualifications: Design precast concrete members under direct supervision of a Professional Engineer experienced in design of precast concrete and licensed in Oregon.
- B. Perform work of this section in accordance with requirements of PCI MNL-116, PCI MNL-120, PCI MNL-123, and PCI MNL-135.
- C. Fabricator Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- D. Fabricator Qualifications: Precast concrete fabricator accredited by IAS according to IAS AC157.
- E. Erector Qualifications: Company specializing in erecting products of this section with not less than five years experience.
- F. Design precast concrete members under direct supervision of a Professional Engineer experienced in design of precast concrete and licensed in Oregon.
- G. Welder Qualifications: Qualified within previous 12 months in accordance with AWS D1.1/D1.1M and AWS D1.4/D1.4M.

1.07 PRE-INSTALLATION MEETING

A. Convene a pre-installation conference one week prior to commencing work of this section.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Handle precast members in position consistent with their shape and design. Lift and support only from support points.
- B. Lifting or Handling Devices: Capable of supporting member in positions anticipated during manufacture, storage, transportation, and erection.
- C. Protect members to prevent staining, chipping, or spalling of concrete.
- D. Mark each member with date of production and final position in structure.

1.09 PROJECT CONDITIONS

A. Coordinate the work of framing components not pre-tensioned but associated with the work of this section.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Structural Precast Concrete:
 - 1. Any manufacturer holding a PCI Group C Plant Certification for the types of products specified; see www.pci.org/find/manufacturer.
 - 2. Substitutions: See Section 01 60 00 Product Requirements.

2.02 PRECAST UNITS

- A. Precast Structural Concrete Units: Comply with PCI MNL-116, PCI MNL-120, PCI MNL-123, PCI MNL-135, ACI 318 and applicable codes.
 - 1. Design components to withstand dead loads and design loads in the configuration indicated on the drawings and provided by Structural Engineer.
 - 2. Calculate structural properties of framing members in accordance with ACI 318.
 - 3. Design members exposed to the weather to provide for movement of components without damage, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to seasonal or cyclic day/night temperature ranges.
 - 4. Design system to accommodate construction tolerances, deflection of other building structural members and clearances of intended openings.

2.03 MATERIALS

- A. Cement: White Portland type, complying with ASTM C150/C150M, Type I.
- B. Aggregate, Sand, Water, Admixtures: Determined by precast fabricator as appropriate to design requirements and PCI MNL-116.

2.04 REINFORCEMENT

- A. Tensioning Steel Tendons: ASTM A416/A416M, Grade 250 (1725); seven-wire stranded steel cable; low-relaxation type; full length without splices; weldless; uncoated.
- B. Reinforcing Steel: ASTM A615/A615M, Grade 40 (40,000 psi).
 - 1. Deformed billet-steel bars.
- C. Steel Welded Wire Reinforcement: ASTM A1064/A1064M plain type or deformed type; in flat sheets; unfinished.

2.05 ACCESSORIES

- A. Connecting and Supporting Devices; Anchors and Inserts: Plates, angles, items cast into concrete, items connected to steel framing members, and inserts conforming to PCI MNL-123, and as follows:
 - 1. Material: Carbon steel conforming to ASTM A36/A36M.
 - 2. Finish: Prime painted, except where device surfaces will be in contact with concrete or will require field welding.
- B. Grout:
 - 1. Non-shrink, non-metallic, minimum yield strength of 10,000 psi at 28 days.
 - 2. Epoxy.
- C. Bearing Pads: High density plastic, Vulcanized elastomeric compound molded to size, Neoprene (Chloroprene), or Tetrafluoroethylene(TFE); Shore A Durometer 60; 1/8 inch thick, smooth both sides.
- D. Bolts, Nuts and Washers: High strength steel type recommended for structural steel joints.
- E. Extruded Polystyrene Board Insulation: ASTM C578, Type IV, 1.60 lb/cu. ft. (26 kg/cu. m), square edges with a thickness of 4 inches.
- F. Wythe connectors: glass fiber connectors manufactured to connect wythes of precast concrete panels. Notched for retention.
- G. Prime Paint: Zinc rich alkyd type.

2.06 FABRICATION

- A. Comply with fabrication procedures specified in PCI MNL-116.
- B. Fabricate and handle epoxy-coated reinforcing bars in accordance with ASTM D3963/D3963M.
- C. Maintain plant records and quality control program during production of precast members. Make records available upon request.
- D. Ensure reinforcing steel, anchors, inserts, plates, angles, and other cast-in items are embedded and located as indicated on shop drawings.

- E. Tension reinforcement tendons as required to achieve design load criteria.
- F. Provide required openings with a dimension larger than 10 inches and embed accessories provided under other sections of the specifications, at indicated locations.
- Exposed Ends at Stressing Tendons: Fill recess with non-shrink grout, trowel flush. G.

2.07 CASTING INSULATED WALL PANELS

- Cast and screed wythe supported by mold. A.
- Place insulation boards abutting edges and ends of adjacent boards. Insert wythe connectors through R insulation, and consolidate concrete around connectors according to connector manufacturer's written instructions.
- C. Cast and screed top wythe to meet required finish.

2.08 FINISHES

- A. Ensure exposed-to-view finish surfaces of precast concrete members are uniform in appearance.
- Cure members under identical conditions to develop required concrete quality, and minimize R appearance blemishes such as non-uniformity, staining, or surface cracking.

2.09 FABRICATION TOLERANCES

A. Conform to fabrication tolerances specified in PCI MNL-135.

2.10 SOURCE QUALITY CONTROL

- A. Section 01 40 00 Quality Requirements: Provide mix design for concrete.
- B. Test samples in accordance with applicable ASTM standard.

PART 3 EXECUTION

3.01 EXAMINATION

Verify that site conditions are ready to receive work and field measurements are as indicated on shop A. drawings.

3.02 PREPARATION

A. Prepare support equipment for the erection procedure, temporary bracing, and induced loads during erection.

3.03 ERECTION

- A. Erect members without damage to structural capacity, shape, or finish. Replace or repair damaged members.
- Align and maintain uniform horizontal and vertical joints, as erection progresses. B.
- C. Maintain temporary bracing in place until final support is provided. Protect members from staining.
- D. Provide temporary lateral support to prevent bowing, twisting, or warping of members.
- E. Adjust differential camber between precast members to tolerance before final attachment.
- F. Install bearing pads.
- Level differential elevation of adjoining horizontal members with grout to maximum slope of 1:12. G.
- H. Set vertical units dry, without grout, attaining joint dimension with lead or plastic spacers.
- Ι. Grout underside of column bearing plates.
- Secure units in place. Perform welding in accordance with AWS D1.1/D1.1M. J.

3.04 TOLERANCES

- A. Erect members level and plumb within allowable tolerances.
- B. Comply with PCI MNL-135 for erection tolerances, except as specifically amended below.
- C. When members cannot be adjusted to comply with design or tolerance criteria, cease work and advise Engineer. Execute modifications as directed.

3.05 PROTECTION

A. Protect members from damage caused by field welding or erection operations.

3.06 CLEANING

A. Clean weld marks, dirt, or blemishes from surface of exposed members.

SECTION 03 5400 CAST UNDERLAYMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Liquid-applied self-leveling floor underlayment.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

- A. ASTM C1602/C1602M Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2012.
- B. ASTM C472 Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete; 1999 (Reapproved 2014).
- C. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- D. Finished Floor Goods Procedures Manufacturer's Procedures for Attaching Finished Floor Goods to Underlayment.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's data sheets documenting physical characteristics and product limitations of underlayment materials. Include information on surface preparation, environmental limitations, and installation instructions.
- C. Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer's Instructions.

1.05 QUALITY ASSURANCE

- A. Underlayment mix shall be tested for a slump using a 2" (i.d.) x 4" cylinder resulting in a patty size of 7-1/2" plus or minus 1/2 inch diameter.
- B. Compressive strength tested in accordance with ASTM C 472M.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Keep dry and protect from direct sun exposure, freezing, and ambient temperature greater than 105 degrees F.

1.07 FIELD CONDITIONS

- A. Do not install underlayment until floor penetrations and peripheral work are complete.
- B. Maintain minimum ambient temperatures of 50 degrees F 24 hours before, during and 72 hours after installation of underlayment.
- C. During the curing process, ventilate spaces to remove excess moisture.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Gypsum Underlayment:
 - 1. Hacker Industries, Inc: www.hackerindustries.com/#sle.
 - 2. Maxxon Corporation: www.maxxon.com/#sle.
 - 3. USG: www.usg.com/#sle.
 - 4. Substitutions: See Section 01 6000 Product Requirements.
2.02 MATERIALS

- A. Gypsum-Based Underlayment: Gypsum based mix, that when mixed with water in accordance with manufacturer's directions will produce self-leveling underlayment with the following properties:
 - 1. Compressive Strength: Minimum 4000 psi, tested per ASTM C472M.
 - 2. Density: Maximum 125 pounds per cubic foot.
 - 3. Final Set Time: 1 to 2 hours, maximum.
 - 4. Thickness: 1-1/2 inch typical, 3/4 inch minimum.
 - 5. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0 in accordance with ASTM E84.
 - 6. Primer Sealer: Seal all areas that receive glue down floor goods according to manufacturer's specifications.
- B. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to underlayment mix materials.
- C. Primer: Manufacturer's recommended type.
- D. Joint and Crack Filler: Latex based filler, as recommended by manufacturer.

2.03 MIXING

- A. Site mix materials in accordance with manufacturer's instructions.
- B. Mix to self-leveling consistency without over-watering.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are clean, dry, unfrozen, do not contain petroleum byproducts, or other compounds detrimental to underlayment material bond to substrate.
- B. Review exact locations for leveling with architect.

3.02 PREPARATION

- A. Remove substrate surface irregularities. Fill voids and deck joints with filler. Finish smooth.
- B. Vacuum clean surfaces.
- C. Prime substrate in accordance with manufacturer's instructions. Allow to dry.
- D. Close floor openings.

3.03 APPLICATION

- A. Install underlayment in accordance with manufacturer's instructions.
- B. Pump or pour material onto substrate. Do not retemper or add water.
 - 1. Pump, move, and screed while the material is still highly flowable.
 - 2. Be careful not to create cold joints.
 - 3. Wear spiked shoes while working in the wet material to avoid leaving marks.
- C. Place to indicated thickness, with top surface level to 1/8 inch in 10 ft.
- D. Place before partition installation.
- E. If a fine, feathered edge is desired, steel trowel the edge after initial set, but before it is completely hard.

3.04 CURING

- A. Once underlayment starts to set, prohibit foot traffic until final set has been reached.
- B. Air cure in accordance with manufacturer's instructions.

3.05 PREPARATION FOR INSTALLATION OF GLUE DOWN FLOOR GOODS

A. Sealing:

- 1. Seal all areas that receive glue down floor goods to manufacturer's specifications. Any floor areas where the surface has been damaged shall be cleaned and sealed regardless of floor covering to be used. Where floor goods manufacturers require special adhesive, their requirements supersede these recommendations.
- B. Moisture Testing:
 - 1. ASTM F2170 Test Method for Determining Relative Humidity in Concrete. Follow the respective floor goods manufacturers' recommendations for relative humidity requirements. When manufacturer does not have a relative humidity requirement, refer to underlayment manufacturer's procedures for attaching finished floor goods.

SECTION 04 2000 UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete block.
- B. Mortar and grout.
- C. Reinforcement and anchorage.
- D. Flashings.
- E. Installation of Lintels.
- F. Accessories.
- G. Masonry Cleaning.

1.02 RELATED REQUIREMENTS

- A. Section 03 2000 Concrete Reinforcing: Reinforcing steel for grouted masonry.
- B. Section 05 5000 Metal Fabrications: Loose steel lintels.
- C. Section 07 1900 Water Repellents.
- D. Section 07 2100 Thermal Insulation: Insulation for cavity spaces.
- E. Section 07 2500 Weather Barriers: Sealing of penetrations made by masonry veneer anchors
- F. Section 07 9200 Joint Sealants: Sealing control and expansion joints.
- G. Section : Backing rod and sealant at control and expansion joints.
- H. Section 09 96 23 Anti Graffiti Coating.

1.03 REFERENCE STANDARDS

- A. ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- B. ASTM A240/A240M Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2022.
- C. ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- D. ASTM A951/A951M Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2016, with Editorial Revision (2018).
- E. ASTM C90 Standard Specification for Loadbearing Concrete Masonry Units; 2021.
- F. ASTM C91/C91M Standard Specification for Masonry Cement; 2018.
- G. ASTM C129 Standard Specification for Nonloadbearing Concrete Masonry Units; 2017.
- H. ASTM C140/C140M Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units; 2022a.
- I. ASTM C144 Standard Specification for Aggregate for Masonry Mortar; 2018.
- J. ASTM C150/C150M Standard Specification for Portland Cement; 2021.
- K. ASTM C207 Standard Specification for Hydrated Lime for Masonry Purposes; 2018.
- L. ASTM C270 Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.
- M. ASTM C404 Standard Specification for Aggregates for Masonry Grout; 2018.
- N. ASTM C476 Standard Specification for Grout for Masonry; 2020.
- O. ASTM C780 Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2020.

- P. ASTM C1072 Standard Test Methods for Measurement of Masonry Flexural Bond Strength; 2019.
- Q. ASTM C1314 Standard Test Method for Compressive Strength of Masonry Prisms; 2021.
- R. ASTM E514/E514M Standard Test Method for Water Penetration and Leakage Through Masonry; 2020.
- S. BIA Technical Notes No. 7 Water Penetration Resistance Design and Detailing; 2017.
- T. BIA Technical Notes No. 13 Ceramic Glazed Brick Exterior Walls; 2017.
- U. BIA Technical Notes No. 28B Brick Veneer/Steel Stud Walls; 2005.
- V. BIA Technical Notes No. 46 Maintenance of Brick Masonry; 2017.
- W. TMS 402/602 Building Code Requirements and Specification for Masonry Structures; 2016.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.

1.05 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for masonry units, mortar, and masonry accessories.
- C. Samples: Submit two samples of facing brick units to illustrate color, texture, and extremes of color range.
- D. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
- E. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.

1.06 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
- B. Installer: Company specializing in performing the work of this Section with minimum three years documented experience.
- C. Advance notices: Notify Architect and Testing Lab at least 48 hours before Grout placement.

1.07 MOCK-UP

- A. Construct a masonry wall as a mock-up panel sized 8 feet long by 6 feet high; include mortar, accessories, structural backup, and flashings (with lap joint, corner, and end dam) in mock-up.
- B. Show masonry color range and pattern, texture, typical coursing, bond, reinforcing, joint treatment, mortar color, angled and square corner construction, wall-top stepping, etc.
- C. Accepted mockups represent minimum acceptable workmanship standard.
- D. Locate where directed.
- E. Mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

- A. Manufacturers:
 - 1. Willamette Graystone, LLC.
 - 2. Substitutions: See Section 01 6000 Product Requirements.

- B. Concrete Block: Comply with referenced standards and as follows:
 - 1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depths as indicated on drawings for specific locations.
 - 2. Special Shapes: Provide non-standard blocks configured for corners, lintels, and other detailed conditions. Field cut stretchers to make Bond Beams in CMU to assure color uniformity.
 - 3. Non-Loadbearing Units (Veneer): ASTM C129.
 - a. Hollow block.
 - b. Medium weight.
 - c. Exposed faces: Ground face where indicated on Drawings.
 - d. Color: As scheduled.
 - 4. Units with Integral Water Repellent: Concrete block units as specified in this section with polymeric liquid admixture added to concrete masonry units at the time of manufacture.
 - a. Performance of Units with Integral Water Repellent:
 - 1) Water Permeance: When tested per ASTM E514/E514M and for a minimum of 72 hours.
 - (a) No water visible on back of wall above flashing at the end of 24 hours.
 - (b) No flow of water from flashing equal to or greater than 0.032 gallons per hour at the end of 24 hours.
 - (c) No more than 25 percent of wall area above flashing visibly damp at end of test.
 - 2) Flexural Bond Strength: ASTM C1072; minimum 10 percent increase.
 - 3) Compressive Strength: ASTM C1314; maximum 5 percent decrease.
 - b. Use only in combination with mortar that also has integral water repellent admixture.
 - c. Use water repellent admixtures for masonry units and mortar by a single manufacturer.

2.02 MORTAR AND GROUT MATERIALS

- A. Masonry Cement: ASTM C91/C91M, Type N.
- B. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.
- C. Hydrated Lime: ASTM C207, Type S.
- D. Mortar Aggregate: ASTM C144.
- E. Grout Aggregate: ASTM C404.
- F. Water: Clean and potable.
- G. Integral Water Repellent Admixture for Mortar: Polymeric liquid admixture added to mortar at the time of manufacture.
 - 1. Use only in combination with masonry units manufactured with integral water repellent admixture.
 - 2. Use only water repellent admixture for mortar from the same manufacturer as water repellent admixture in masonry units.
 - 3. Meet or exceed performance specified for water repellent admixture used in masonry units.

2.03 REINFORCEMENT AND ANCHORAGE

- A. Manufacturers:
 - 1. Blok-Lok Limited: www.blok-lok.com.
 - 2. Hohmann & Barnard, Inc: www.h-b.com.
 - 3. Substitutions: See Section 01 6000 Product Requirements.
- B. Reinforcing Steel: Type specified in Section 03 2000; size as indicated on drawings; uncoated finish.
- C. Single Wythe Joint Reinforcement: ASTM A951/A951M.

- D. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
 - 1. Similar to Hohmann & Barnard, Inc. with Pencil Rod.
 - a. At Frame Walls: HB-213S with HB 213 T-Lok Tie Adjustable Veneer Anchor, galvanized, Depth approximately 6 inches from face of sheathing at frame walls to center of veneer.
 - 2. Anchor plates: Not less than 0.075 inch thick, designed for fastening to structural backup through sheathing by two fasteners. Provide anchor depth as required to center Pencil Rod within masonry mortar bed.
 - 3. Pencil Rod: 9 gage, galvanized as indicated above.
 - 4. Vertical adjustment: Not less than 3-1/2 inches.
 - 5. Fasteners: Stainless steel.
 - 6. Seismic Feature: Provide lip, hook, or clip on end of wire ties to engage or enclose not less than one continuous horizontal joint reinforcement wire of 0.1483 inch diameter.
- E. Masonry Veneer Vertical Joint Reinforcing: Hot-dipped galvanized; similar to Dur-O-Wall JSA-2200, or approved.
 - 1. Wires: 2 each, 8 gage, #304 stainless steel. Shape and length based on condition for 1/2 inch control joint.

2.04 FLASHINGS

- A. Metal Flashing Materials:
 - 1. Stainless Steel Flashing: ASTM A666, Type 304, soft temper; 26 gauge, 0.0187 inch thick; finish 2B to 2D.
- B. Self-Adhered Membrane: Self-adhesive sheet flashing, ASTM D 1970.
 - 1. Self-Adhered Membrane: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.025 inch.
 - a. Verify material selection with Work of Section 07 25 00 Weather Barriers for compatibility of materials.
 - b. Products:
 - 1) Grace Construction Products, a unit of W. R. Grace & Co. Conn.; Perm-A-Barrier Wall Flashing.
 - 2) Henry Company; Blueskin VP 160.
 - 3) Substitutions: See Section 01 60 00 Product Requirements.
- C. Combination Non-Asphaltic Flashing Materials Stainless Steel:
 - 1. Stainless Steel Flashing Self-adhering: ASTM A240/A240M; 2 mil type 304 stainless steel sheet with 8 mil of butyl adhesive and a removable release liner.
 - a. Manufacturers:
 - 1) STS Coatings, Inc; ____: www.stscoatings.com/#sle.
 - 2) VaproShield, LLC; ____: www.vaproshield.com/#sle.
 - 3) WIRE-BOND; ____: www.wirebond.com/#sle.
 - 4) York Manufacturing, Inc; York 304: www.yorkmfg.com/#sle.
 - 5) Substitutions: See Section 01 6000 Product Requirements.
- D. Stainless Steel/Polymer Fabric Flashing: ASTM A240/A240M; 2 mil type 304 stainless steel sheet bonded on one side to one sheet of polymer fabric.
 - 1. Manufacturers:
 - a. Hohmann & Barnard, Inc; Mighty-Flash Stainless Flashing: www.h-b.com/#sle.
 - b. WIRE-BOND; ____: www.wirebond.com/#sle.
 - c. York Manufacturing, Inc; Multi-Flash SS: www.yorkmfg.com/#sle.
 - d. Substitutions: See Section 01 6000 Product Requirements.
- E. Stainless Steel/Polymer Fabric Drainage Plane Flashing: ASTM A240/A240M; 2 mil type 304 stainless steel sheet bonded between one sheet of polymer fabric and one sheet of non-woven drainage material.

- 1. Manufacturers:
 - a. STS Coatings, Inc; ____: www.stscoatings.com/#sle.
 - b. York Manufacturing, Inc; Flash-Vent SS: www.yorkmfg.com/#sle.
 - c. Substitutions: See Section 01 6000 Product Requirements.
- F. Stainless Steel/Polymer Fabric Drainage Plane Flashing Self-Adhering: ASTM A240/A240M; 2 mil type 304 stainless steel sheet with co-polymer butyl adhesive and a removable release liner on one side and a sheet of nonwoven drainage material bonded to the other side.
 - 1. Manufacturers:
 - a. York Manufacturing, Inc; Flash-Vent SA: www.yorkmfg.com/#sle.
 - b. Substitutions: See Section 01 6000 Product Requirements.
- G. Factory-Fabricated Flashing Corners and End Dams: Stainless steel.

2.05 ACCESSORIES

- A. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
 - 1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.
 - a. Manufacturers:
 - 1) Advanced Building Products, Inc; Mortar Break DT: www.advancedbuildingproducts.com.
 - 2) Advanced Building Products Inc; Mortar Break: www.advancedbuildingproducts.com.
 - 3) Mortar Net Solutions; MortarNet: www.mortarnet.com.
 - 4) York Manufacturing, Inc: www.yorkmfg.com.
 - 5) Substitutions: See Section 01 6000 Product Requirements.
- B. Weeps: Cellular plastic. One piece, flexible extrusion made form UV- resistant polypropylene copolymer, full heights and width of head joint and depth 1/8 less than depth of out wythe, color selection from manufacturer's standard.
 - 1. Manufacturers:
 - a. Advanced Building Products Inc; Product Mortar Maze weep vent.
 - b. Hohmann & Barnard, Inc; Product Quadro-Vent: www.h-b.com.
 - c. WIRE-BOND; Product Cell Vent #3601: www.wirebond.com.
 - d. Mortar Net Solutions; Mortar Net CellVent: www.mortarnet.com.
 - e. Substitutions: See Section 01 6000 Product Requirements.
- C. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials; approved by masonry manufacturer, compatible with water repellent specified in Section 07 1900.

2.06 LINTELS

A. Steel lintels provided by Section 05 5000 - Metal Fabrication.

2.07 MORTAR AND GROUT MIXING

- A. Mortar for Unit Masonry: ASTM C270, using the Property Specification.
 - 1. Loadbearing masonry: Type S (1800 psi).
 - 2. Non-loadbearing masonry: Type N (750 psi).
 - 3. Color: Natural Gray.
- B. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
- C. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.
- D. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.
- C. Coordinate masonry work with installation of windows, doors, louvers, anchors, concrete slabs, and mechanical and electrical work.

3.03 COLD AND HOT WEATHER REQUIREMENTS

A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

3.04 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
 - 1. Bond: Running.
 - 2. Coursing: One unit and one mortar joint to equal 8 inches.
 - 3. Mortar Joints: Concave.

3.05 PLACING AND BONDING

- A. Lay hollow masonry units with face shell bedding on head and bed joints.
- B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- C. Remove excess mortar and mortar smears as work progresses.
- D. Interlock intersections and external corners, except for units laid in stack bond.
- E. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- F. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

3.06 WEEPS/CAVITY VENTS

- A. Install weeps in veneer and cavity walls at 24 inches on center horizontally on top of through-wall flashing above shelf angles and lintels and at bottom of walls.
- B. Install cavity vents in veneer and cavity walls at 32 inches on center horizontally below shelf angles and lintels and near top of walls.

3.07 CAVITY MORTAR CONTROL

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
- B. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.08 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

A. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 24 inches on center vertically and 32 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.

B. Seismic Reinforcement: Connect veneer anchors with continuous horizontal wire reinforcement before embedding anchors in mortar.

3.09 MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
 - 1. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry or turn up flashing ends at least 1 inch, minimum, to form watertight pan at non-masonry construction.
 - 2. Remove or cover protrusions or sharp edges that could puncture flashings.
 - 3. Seal lapped ends and penetrations of flashing before covering with mortar.
- B. Terminate flashing up 8 inches minimum on vertical surface of backing:
 - 1. Install vertical leg of flashing behind water-resistive barrier sheet over backing.
 - 2. Install vertical leg of flashing over fluid-applied or self-adhered air/vapor barriers over backing or per manufacturer92s directions.
 - 3. Anchor vertical leg of flashing into backing with a termination bar and sealant.
 - 4. Apply cap bead of sealant on top edge of self-adhered flashing.
- C. Install flashing in accordance with manufacturer's instructions and BIA Technical Notes No. 7.
- D. Extend metal flashings through exterior face of masonry and terminate in an angled drip with hemmed edge. Install joint sealer below drip edge to prevent moisture migration under flashing.
- E. Support flexible flashings across gaps and openings.
- F. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.
- G. Thru-Wall Flashing
 - 1. Extend flashings through veneer, turn up minimum of 6 inches above top of concrete curb/base, and seal to exterior wall sheathing. Use flashing manufacturer's recommended adhesive and sealer.
 - 2. Lap weather barrier over vertical leg of flashing
 - 3. Lap thru-wall flashings over stainless steel flashing as shown on Drawings, to within 1/4 inch of exterior face of masonry.

3.10 LINTELS

- A. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled.
 - 1. Openings over 78 inches: Reinforce openings as detailed.
- B. Maintain minimum 8 inch bearing on each side of opening unless otherwise shown.

3.11 GROUTED COMPONENTS

- A. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
- B. Place and consolidate grout fill without displacing reinforcing.

3.12 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Form expansion joint as detailed on drawings.

3.13 BUILT-IN WORK

- A. As work progresses, install built-in metal door frames and glazed frames and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.

3.14 TOLERANCES

A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.

- B. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- C. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
- D. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
- E. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.
- F. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.15 CUTTING AND FITTING

- A. Cut and fit for pipes, conduit, and sleeves. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.16 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
- B. An independent testing agency will perform special inspection, as specified in Section 01400, to observe placement of reinforcing for masonry construction required to have Special Inspection as indicated on the Drawings.
- C. Concrete Masonry Unit Tests: Test each variety of concrete unit masonry in accordance with ASTM C140/C140M for compliance with requirements of this specification.
- D. Mortar Tests: Test each type of mortar in accordance with ASTM C780, testing with same frequency as masonry samples.

3.17 CLEANING

- A. Remove excess mortar and mortar droppings.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.
- D. Use non-metallic tools in cleaning operations.

3.18 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

SECTION 05 1200 STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Structural steel framing members.
- B. Anchor bolts and stetting templates for structural steel.
- C. Grouting under base plates.

1.02 RELATED REQUIREMENTS

- A. Section 03 10 00 Concrete Forms and Accessories: Placement of Anchor Bolts & Embeds.
- B. Section 06 1000 Rough Carpentry: Wood framing interfacing with steel framing.
- C. Section 06 1800 Glue-Laminated Construction: Wood beams that frame into steel columns.

1.03 REFERENCE STANDARDS

- A. AISC (MAN) Steel Construction Manual; 2017.
- B. AISC 303 Code of Standard Practice for Steel Buildings and Bridges; 2016.
- C. AISC S303 Code of Standard Practice for Steel Buildings and Bridges, American Institute of Steel Construction, Inc.; latest edition, Chapter 10 (Architecturally Exposed Structural Steel).
- D. ASTM A36/A36M Standard Specification for Carbon Structural Steel; 2019.
- E. ASTM A53/A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2020.
- F. ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- G. ASTM A307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- H. ASTM A500/A500M Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2021a.
- I. ASTM A563 Standard Specification for Carbon and Alloy Steel Nuts; 2021a.
- J. ASTM A563M Standard Specification for Carbon and Alloy Steel Nuts (Metric); 2021a.
- K. ASTM A992/A992M Standard Specification for Structural Steel Shapes; 2020.
- L. ASTM F3125/F3125M Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2021.
- M. ASTM F436/F436M Standard Specification for Hardened Steel Washers Inch and Metric Dimensions; 2019.
- N. ASTM F436 Standard Specification for Hardened Steel Washers; 2011.
- O. ASTM F1554 Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2020.
- P. ASTM F3125/F3125M Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2021.
- Q. AWS A2.4 Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
- R. AWS D1.1/D1.1M Structural Welding Code Steel; 2020, with Errata (2021).
- S. IAS AC172 Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.

- T. RCSC (HSBOLT) Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections; 2020.
- U. OSSC Oregon Structural Specialty Code; current edition.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, fasteners, and finish.
 - 2. Connections not detailed.
 - 3. Indicate cambers.
 - 4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.
 - 5. Indicate locations, critical dimensions, required clearances, construction details, installation methods including any splices, attachments and anchors. Show holes, threaded fasteners, and welds.
 - 6. Indicate which members are considered as Architecturally Exposed Structural Steel.
 - 7. Indicate members to be galvanized, location and size of drain holes, and which members are to receive field finish painting that may impact the galvanizing process.
 - 8. Indicate portions of members not to be painted due to member receiving fire proofing, in contact with concrete, or connected with slip critical-bolts.
- C. Material Samples:
 - 1. Submit sample of all required welds. Approved sample will be used as the standard for all welding.
 - 2. Submit one sample of hot-dipped galvanized finish on a fully welded assembly.
 - a. Intent is to approve quality of finish at steel of Entry Canopy as well as exposed structural steel supports along roof edge.
- D. Mill Test Reports: Indicate structural strength, destructive test analysis and non-destructive test analysis.
- E. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.05 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with AISC (MAN) "Steel Construction Manual."
- B. Fabricator: Company specializing in performing the work of this section with minimum five years of successful documented experience.
- C. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Recycled Content: Steel W, T, HSS, Pipe, Angles, Plates, Channels, and Bars are to meet or exceed the industry standards for recycled content for the electric arc furnace process. Post-consumer content of 56%, Pre-consumer content of 32%.
- B. Steel Angles, Plates, Channels, and Bars: ASTM A36/A36M unless otherwise indicated on Drawings.
- C. Steel W Shapes and Tees: ASTM A992/A992M (Fy = 50 ksi).
- D. Cold-Formed Structural Tubing and Hollow Structural Sections: ASTM A500, Grade B.
- E. Pipe: ASTM A53/A53M, Grade B, Finish black. Sulfur not exceeding 0.05%, (Fy=35 ksi). Type S where exposed to view, type E where concealed from view.

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- F. Steel Tie Rods: ASTM A 572, Grade 50, (Fy=50 ksi).
- G. Structural Bolts and Nuts: Carbon steel, ASTM A307, Grade A and galvanized in compliance with ASTM A153/A153M, Class C.
- H. High-Strength Structural Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, with matching compatible ASTM A563 or ASTM A563M nuts and ASTM F436/F436M washers.
- I. Unheaded Anchor Rods and Bolts: ASTM F1554, Grade 36, plain, heavy hex head, with matching ASTM A563 or A 563M nuts and ASTM F436 Type 1 washers, unless otherwise noted.
- J. Threaded Studs: Fusion welded, Nelson CPL type, size as noted on Drawings, length as required for full engagement of nut with washer. Stainless steel 18-8 threaded studs where noted on Drawings for connection to stainless steel material.
- K. Welding Materials: AWS D1.1; type required for materials and conditions being welded.
 1. E70 Low Hydrogen Electrodes.
 - 2. E60 for light gage metal studs and metal decking.
- L. Grout: ASTM C1107/C1107M; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
 - 1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch.
 - 2. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch.
 - 3. Products:
 - a. "Euco N.S." manufactured by Euclid Chemical Co.
 - b. "Crystex" manufactured by L&M Construction Chemicals.
 - c. "Masterflow 713" by Master Builders
- M. Shop and Touch-Up Primer: Fabricator's standard, complying with project's VOC limitations.
- N. Touch-Up Primer for Galvanized Surfaces: Fabricator's standard, complying with project's VOC limitations.

2.02 FABRICATION

- A. Shop fabricate to greatest extent possible.
- B. Continuously seal joined members by continuous welds. Grind exposed welds smooth.
- C. Fabricate connections for bolt, nut, and washer connectors. Hole size 1/16 inch larger than bolt diameter unless shown otherwise, 1/8 inch larger than bolt at base plates.

2.03 FINISH

- A. Prepare structural component surfaces in accordance with SSPC SP-6.
- B. Shop prime structural steel members. Do not prime surfaces that will be field welded, in contact with concrete, or high strength bolted.
- C. Where indicated, galvanize steel members to comply with ASTM A123/A123M. Provide minimum 1.7 oz/sq ft galvanized coating. Provide vent holes in closed shapes. Clip end plates, tab plates, and other features to prevent accumulation or pooling of galvanized material.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.02 ERECTION

- A. Erect structural steel in compliance with AISC 303.
- B. Allow for erection loads and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- C. Field weld components and shear studs indicated on shop drawings.

- D. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts".
- E. Do not field cut or alter structural members without approval of Architect.
- F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.
- G. Treat field welded areas of galvanized members with zinc solder to replace galvanized protection.
- H. Touch-up Field Connections and damaged Shop Treatment areas as erection proceeds. Immediately prior to final covering, remove Rust and retreat any Members showing evidence of Rust through Shop Treatment over approximately 5% or more to total Shop Treatment area.
- I. Remove loose rust, heavy Mill Scale, Oil, Dirt, and other bond-reducing Foreign Substances from Members scheduled to receive Finish Painting, or other direct-to-steel Coatings.
- J. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for nonshrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

3.03 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.

3.04 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
- B. An independent testing agency will perform special inspection, as specified in Section 01400 for structural welding in accordance with OSSC 1705.2.

SECTION 05 4000 COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Formed steel stud interior wall and exterior canopy framing.

1.02 REFERENCE STANDARDS

A. ASTM C955 - Standard Specification for Cold-Formed Steel Structural Framing Members; 2018, with Editorial Revision.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

PART 2 PRODUCTS

2.01 FRAMING SYSTEM

A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.

2.02 FRAMING MATERIALS

A. Studs and Track: ASTM C955; studs formed to channel, C- or Sigma-shaped with punched web; U-shaped track in matching nominal width and compatible height.

SECTION 05 5000 METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop fabricated steel items.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 Cast-in-Place Concrete: Placement of metal fabrications in concrete.
- B. Section 04 2000 Unit Masonry: Placement of metal fabrications in masonry.
- C. Section 05 5100 Metal Stairs: Designed and bidder-designed steel stairs.
- D. Section 07 6500 Sheet Metal Flashing and Trim: Sheet metal wrapped around plate steel exterior elements
- E. Section 09 9000 Painting and Coating: Paint finish.
- F. Section 09 9113 Exterior Painting: Paint finish.

1.03 REFERENCE STANDARDS

- A. ASTM A36/A36M Standard Specification for Carbon Structural Steel; 2019.
- B. ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- C. ASTM A283/A283M Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
- D. ASTM A500/A500M Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2021a.
- E. ASTM F3125/F3125M Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2021.
- F. AWS A2.4 Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
- G. AWS D1.1/D1.1M Structural Welding Code Steel; 2020, with Errata (2021).
- H. IAS AC172 Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.
- I. SSPC-Paint 15 Steel Joist Shop Primer/Metal Building Primer; 2004.
- J. SSPC-Paint 20 Zinc-Rich Coating (Type I Inorganic, and Type II Organic); 2019.
- K. SSPC-SP 2 Hand Tool Cleaning; 2018.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, critical dimensions, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
 - 2. Indicate members to be galvanized, location and size of drain holes, and which members are to receive field finish painting that may impact the galvanizing process.
- C. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.
- D. Furnish anchor bolt setting drawings and installation details for steel items provided by this Section.

- E. Material Samples: provide the following material samples unless the fabricator supplying the work of this section is also supplying the work in section 05 1200 Structural Steel.
 - 1. Submit sample of all required welds. Approved sample will be used as the standard for all welding.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified steel fabricator that is accredited by IAS AC172.

1.06 MOCK-UP

- A. Minimum 6 linear feet of steel railing & stanchions complete with pickets, brackets and connections.
- B. Notify Architect when the mock-up is ready to view and prior to preparation for finishing.
- C. Notify Architect again when primer coat is completed.
- D. Notify Architect again when powder coating is completed.
- E. Accepted mock-up may be used as part of the final project.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

- A. Recycled Content: Steel W, T, HSS, Pipe, Angles, Plates, Channels, and Bars are to meet or exceed the industry standards for recycled content for the electric arc furnace process. Post-consumer content of 56%, Pre-consumer content of 32%.
- B. Steel channels, angles, bars, and plates: ASTM A 36/A 36M unless otherwise noted on Drawings.
- C. Steel W Shapes and Tees: ASTM A992/A992M (Fy = 50 ksi).
- D. Steel Tubing and Hollow Steel Sections: ASTM A 500, Grade B cold-formed structural tubing.
- E. Plates: ASTM A283/A283M.
- F. Steel Pipe: ASTM A 53/A 53M, Grade B, with sulfur not exceeding 0.05%, (Fy=35 ksi). Finish black. Type S where exposed to view, type E where concealed from view.
- G. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, plain.
- H. Anchor Bolts, Headed Anchor Rods: ASTM A 307, Grade C, plain.
- I. Stainless Steel Tubing: Type 304, 0.083 inch wall thickness, unless otherwise noted.
- J. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- K. Shop and Touch-Up Primer: SSPC-Paint 15, complying with project's VOC limitations.
- L. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I Inorganic, complying with project's VOC limitations.

2.02 FASTENERS, BOLTS, ANCHORS

- A. Powder-Driven Fasteners: Hilti DX system, or approved. Similar to Hilti DS Heavy Duty Pins.
- B. Post-Installed Concrete Bolts: Simpson Titen HD, Powers Wedge-Bolt, or approved.
- C. Post-Installed Concrete Screws: Simpson Titen Turbo Concrete and Masonry Screws, Hilti Kwik-Con II or approved.
- D. Expansion Anchors: Hilti KB-TZ, or approved: See drawings for size. Hot-dipped galvanized. Stainless steel for attachment into masonry, where exposed, or where noted.
 - 1. Seismic qualification tested in accordance with ACI 355.2 and ICC-ES AC 193.
 - 2. Meets ductility requirements of ACI 318 D 3.3.
 - 3. Meets ICC-ES ESR-1917.
 - 4. Anchors to be used in locations, configurations, and materials only as approved by the manufacturer.

- E. Self-Drilling Screws: ITW Buildex, or approved; type and drill point as required for materials being fastened.
- F. Epoxy Adhesive Anchors for Concrete and Concrete Block:
 - 1. Hilti RE 500-V3, or approved.
 - 2. Concrete and Epoxy preparation as required by epoxy manufacturer's ICBO report.

2.03 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Provide holes and connections for work of other trades.
- D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- G. Fabricate any Structural Connections not specifically detailed on Drawings as Directed by Architect and at no additional cost to Owner. If Directions are not obtained, fabricate consistent with balance of Design and strong enough to fully develop Members involved.
- H. Form elbows and bends to uniform radii, free from buckles and twists, and with finished surfaces smooth.
- I. Cap and fully weld exposed ends of pipe and tubing.

2.04 FABRICATED ITEMS

- A. Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; prime paint finish.
 - 1. Side Rails: 3/8 x 2 inches members spaced at 20 inches.
 - 2. Rungs: one inch diameter solid round bar spaced 12 inches on center.
 - 3. Space rungs 7 inches from wall surface.
 - 4. Top rung level with adjacent roof surface.
- B. Steel Pipe Bollards:
 - 1. 4 inch inside diameter, unless otherwise shown.
 - 2. Provide rounded steel cap at all bollards. Weld cap all around and grind smooth.
- C. Connectors for Wood Columns & Beams:
 - 1. Fabricate as shown on Drawings. Oversize Steel Connectors 1/8 inch to facilitate installation of Wood Members.
 - 2. Minimum Weld Strengths, unless otherwise shown on Drawings: Develop full strength of Steel.
- D. Stainless Steel Handrails:
 - 1. Round Tubing: standard 1 1/4 inch pipe (O.D. 1.660 inches)
 - 2. Plate: 1/4 inch
 - 3. Type: 304
- E. Steel Plate sign panels
 - 1. See drawings for plate size and lettering cut-outs.
 - 2. Mechanically cut lettering as shown on drawings.
 - 3. Prepare and paint steel in accordance with Section 09 9000.

2.05 FINISHES - STEEL

A. Prime paint steel items.

- 1. Exceptions: Galvanize items to be embedded in concrete, items to be embedded in masonry, and items indicated on Drawings.
- 2. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.
- B. Prepare surfaces to be primed in accordance with SSPC-SP2.
- C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- D. Prime Painting: One coat.
- E. Galvanizing: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating.

2.06 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch.
- C. Maximum Misalignment of Adjacent Members: 1/16 inch.
- D. Maximum Bow: 1/8 inch in 48 inches.
- E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Field weld components as indicated on drawings.
- D. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Obtain approval prior to site cutting or making adjustments not scheduled.
- F. Treat field welded areas of galvanized members with zinc solder to replace galvanized protection.
- G. Touch-up Field Connections and damaged Shop Treatment areas as erection proceeds. Immediately prior to final covering, remove Rust and retreat any Members showing evidence of Rust through Shop Treatment over approximately 5% or more to total Shop Treatment area.
- H. Remove loose rust, heavy Mill Scale, Oil, Dirt, and other bond-reducing Foreign Substances from Members scheduled to receive Finish Painting, or other direct-to-steel Coatings.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

SECTION 05 5100 METAL STAIRS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Stairs with concrete and precast concrete treads.
- B. Stairs with metal treads.
- C. Structural steel stair framing and supports.
- D. Handrails and guards.
- E. Prefabricated stair treads and nosings.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 Cast-in-Place Concrete: Concrete fill in stair pans and landings; mesh reinforcement for landings.
- B. Section 05 5220 Railing Cable Systems: Associated guards.
- C. Section 06 2000 Finish Carpentry: Wood accents on guadrails.
- D. Section 09 9000 Painting and Coating: Paint finish.

1.03 REFERENCE STANDARDS

- A. ASTM A6/A6M Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling; 2019.
- B. ASTM A36/A36M Standard Specification for Carbon Structural Steel; 2019.
- C. ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- D. ASTM A240/A240M Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2022.
- E. ASTM A283/A283M Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
- F. ASTM F3125/F3125M Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2021.
- G. AWS A2.4 Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
- H. AWS D1.1/D1.1M Structural Welding Code Steel; 2020, with Errata (2021).
- I. IAS AC172 Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.
- J. SSPC-Paint 15 Steel Joist Shop Primer/Metal Building Primer; 2004.
- K. SSPC-Paint 20 Zinc-Rich Coating (Type I Inorganic, and Type II Organic); 2019.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

1.05 QUALITY ASSURANCE

A. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and dated no more than 12 months before start of scheduled welding work.

- B. A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.
- C. A company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

PART 2 PRODUCTS

2.01 METAL STAIRS - GENERAL

- A. Metal Stairs: Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.
 - 1. Dimensions: As indicated on drawings.
 - 2. Handrails: Comply with applicable accessibility requirements of ADA Standards.
 - 3. Shop assemble components; disassemble into largest practical sections suitable for transport and access to site.
 - 4. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.
- 5. Separate dissimilar metals using paint or permanent tape.

2.02 WEST STAIR (S1) - METAL STAIRS WITH GLU-LAM TREADS

- A. Risers: Closed.
 - 1. Material: Same as tread pans.
- B. Treads: Glu-Lam field-installed concrete fill
 - 1. Concrete Depth: 3- 1/8" inches
 - 2. Aluminum Stair Nosing:
 - a. Type: Single-component stair nosing.
 - b. Basis of Design: Balco, T-213, or Approved Equal.
- C. Risers: Refer to stair details.
 - 1. Riser Material: Perforated Metal, Slotted by McNichols, or Approved Equal.
 - a. Primary Material: Carbon Steel
 - b. Material Finish: Mill Finish, painted
 - c. Gauge/Thickness: 16 gauge, .0598 inch minimum
 - d. Hole Pattern: 1/8" x 1" round-end slot, side staggered centers
 - e. Percent Open Area: 44%
- D. Stringers: hollow steel sections.
 - 1. Stringer Depth: As shown on Drawings.
 - 2. End Closure: Sheet steel plate welded at ends.
- E. Landings: Similar construction to treads, supported and reinforced as required to achieve design load capacity.
- F. Railings: Steel pipe railings as shown on Drawings.
 - 1. Finish: Steel components painted to match steel stair components. Cable railing components to retain factory finish.
- G. Metal Jointing and Finish Quality Levels:
 - 1. Architectural: All joints as inconspicuous as possible, whether welded or mechanical.
 - a. Welded Joints: Continuously welded and ground smooth and flush.
 - b. Mechanical Joints: Butted tight, flush, and hairline; concealed fastenings only.
 - c. Exposed Edges and Corners: Eased to small uniform radius.
 - d. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for highest quality gloss finish.
 - e. Under Side of Stair: Paint all visible steel and finish all sides of treads.

2.03 EXTERIOR METAL STAIRS WITH PRECAST CONCRETE TREADS

- A. Risers: Refer to stair details..
- B. Treads: Pre-cast Concrete Tread..

- 1. Precast Concrete Tread Thickness: 2-1/2" inches, minimum.
- 2. Precast Concrete Treads:
 - a. Concrete Strength: 5,000 psi at 28 days, minimum.
 - b. Air Content: 4 to 6 percent.
 - c. Cement Color: Natural gray.
 - d. Water and Stain Repellent: Protectosil CHEM-TRETE 40 VOC, or approved.
 - e. Aluminum Stair Nosing: Basis of Design; Balco Two-component stair nosings, DST-330, or Approved Equal.
 - f. Anchorage to Tread Pan: Die-cast Zinc Alloy inserts, similar to Dayton Superior P-86 Star Insert
- 3. Anchorage to Stringers: Welded or bolted to carrier angles welded or bolted to stringers.
- C. Stringers: As indicated on drawings.
- D. Railings: As indicated on drawings..
- E. Galvanized after fabrication, except sheet components are to be galvanized before fabrication.
- F. Metal Jointing and Finish Quality Levels:
 - 1. Architectural: All joints as inconspicuous as possible, whether welded or mechanical.
 - a. Welded Joints: Continuously welded and ground smooth and flush.
 - b. Mechanical Joints: Butted tight, flush, and hairline; concealed fastenings only.
 - c. Exposed Edges and Corners: Eased to small uniform radius.
 - d. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for highest quality gloss finish.
 - e. Under Side of Stair: Paint all visible steel and finish all sides of treads.

2.04 MATERIALS

- A. Steel Sections: ASTM A 36/A 36M.
- B. Steel Plates: ASTM A6/A6M or ASTM A283/A283M, or ASTM 240 / 240M.
- C. Stainless Pipe: ASTM A240 / 240M, #4 finish.

2.05 ACCESSORIES

- A. Steel Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, and galvanized to ASTM A153/A153M where connecting galvanized components.
- B. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- C. Shop and Touch-Up Primer: SSPC-Paint 15, and comply with VOC limitations of authorities having jurisdiction.
- D. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I Inorganic, and comply with VOC limitations of authorities having jurisdiction.

2.06 SHOP FINISHING

- A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- B. Do not prime surfaces in direct contact with concrete or where field welding is required.
- C. For Interior Stairs:
 - 1. Prime Painting: Use specified shop- and touch-up primer.
 - 2. Preparation of Steel: In accordance with SSPC-SP6, Commercial Blast Cleaning.
 - 3. Finish: as indicated in Section 09 9000
- D. For Exterior Stairs:
 - 1. Galvanizing: Hot-dip galvanize to minimum requirements of ASTM A123/A123M.
 - 2. Preparation of Steel: In accordance with SSPC-SP6, Commercial Blast Cleaning.
 - 3. Touch up abraded areas after fabrication using specified touch-up primer for galvanized surfaces.
 - 4. Finish: as indicated in Section 09 9000

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 INSTALLATION

- A. Install components plumb and level, accurately fitted, free from distortion or defects.
- B. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Provide welded field joints where specifically indicated on drawings. Perform field welding in accordance with AWS D1.1/D1.1M.
- D. Other field joints may be either welded or bolted provided the result complies with the limitations specified for jointing quality levels.
- E. Obtain approval prior to site cutting or creating adjustments not scheduled.
- F. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.03 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.

SECTION 05 5220 RAILING CABLE SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Stainless steel cable and fittings for railing infill.

1.02 RELATED SECTIONS

A. Section 05 5100 Metal Stairs

1.03 SUBMITTALS

- A. Reference Section 01 3000-Submittal Procedures; submit following items:
 - 1. Product Data.
 - 2. Shop Drawings: Indicate materials, sizes, fabrication, anchorage and installation details, and lengths for cable systems on shop drawings prepared by fabricator of cable supporting structure.
 - 3. Samples: Minimum 12 inch (300 mm) length of cable and each fitting and accessory proposed for the Project. Submit items in specified finish.
 - 4. Quality Assurance/Control Submittals:
 - a. Qualifications: Proof of manufacturer's qualifications.
 - b. Manufacturer's Installation Instructions.
- B. Closeout Submittals: Reference Section 01 7800-Closeout Submittals; submit following items:
 - 1. Maintenance Instructions:
 - a. Manufacturer's recommendation for periodic checking and adjustment of cables to maintain uniform cable tension.
 - b. Manufacturer's recommendation for periodic cleaning to remove accumulated dirt, debris, and stains.

1.04 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer Qualifications: Minimum five years experience in producing cable assemblies of the type specified.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Reference Section 01 6000-Product Storage and Handling Requirements.
- B. Follow manufacturer's instructions.

1.06 WARRANTY

A. Special Warranty: Stainless steel cables and connectors - 10 year limited warranty against defects in materials and workmanship.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Feeney Wire Rope & Rigging; www.cablerail.com
 - 1. 2603 Union Street, Oakland, CA 946073
 - 2. Toll Free: (800) 888-2418 Fax:(510) 893-9484
 - 3. Product: CableRail cable assemblies and fittings.
- B. Substitutions: See Section 01 6000 Product Requirements.

2.02 MATERIALS

- A. Cables: Type 316 stainless steel, polished finish, commercial, dry grade.
 1. Size: 3/16 inch (6.4 mm) diameter, 1x19 construction, stainless steel.
- B. Fittings: All fittings to be Type 316 stainless steel.
 - 1. Swage Style: Vibratory/tumbled finish.
 - 2. Angled Terminations

- a. Exposed Fixed Ends: Jawend / Sleekline jaw turnbuckle. Provide commercial lock pins.
- C. Accessories: Stainless steel protector sleeves, rubber grommets, beveled washers and additional accessories as recommended by manufacturer for installation conditions.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine work to which cables will be anchored or will penetrate. Coordinate with responsible entity to perform corrective work as necessary.
 - 1. Verify post size and cable spacing are in accordance with manufacturer's recommendations.
- B. Take field measurements and compare installation conditions to shop drawings. Notify manufacturer if field measurements vary from shop drawings.

3.02 INSTALLATION

- A. Follow manufacturer's installation instructions.
- B. Isolate dissimilar metals with grommets or bushings.

3.03 CLEANING

A. Clean cables thoroughly using synthetic scotch type pads and hot soapy water to remove residual lubricants; rinse thoroughly with clear water and wipe dry.

SECTION 06 1000 ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Structural dimension lumber framing.
- B. Rough opening framing for doors, windows, and roof openings.
- C. Sheathing.
- D. Subflooring.
- E. Roof-mounted curbs.
- F. Roofing nailers.
- G. Manufactured lumber.
- H. Preservative treated wood materials.
- I. Miscellaneous framing and sheathing.
- J. Communications and electrical room mounting boards.
- K. Concealed wood blocking, nailers, and supports.
- L. Anchor Bolts and embeds for Rough Carpentry.

1.02 RELATED REQUIREMENTS

- A. Section 01 6116 Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 06 1733 Wood I-Joists.
- C. Section 06 1800 Glued-Laminated Construction.
- D. Section 06 2000 Finish Carpentry
- E. Section 07 2500 Weather Barriers: Air barrier over sheathing.
- F. Section 09 2116 Gypsum Board Assemblies: Gypsum-based sheathing.

1.03 REFERENCE STANDARDS

- A. AFPA (WFCM) Wood Frame Construction Manual for One- and Two-Family Dwellings; 2012.
- B. ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- D. ASTM C557 Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 2003 (Reapproved 2017).
- E. ASTM D3498 Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing; 2019a.
- F. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- G. AWPA U1 Use Category System: User Specification for Treated Wood; 2018.
- H. OSSC Oregon Structural Specialty Code; latest edition.
- I. PS 1 Structural Plywood; 2009 (Revised 2019).
- J. PS 2 Performance Standard for Wood-Based Structural-Use Panels; 2010.
- K. PS 20 American Softwood Lumber Standard; 2020.
- L. WWPA G-5 Western Lumber Grading Rules; 2017.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

- B. Product Data: Provide technical data on wood preservative materials.
- C. Structural Composite Lumber: Submit manufacturer's published structural data including span tables, marked to indicate which sizes and grades are being used; if structural composite lumber is being substituted for dimension lumber or timbers, submit grading agency structural tables marked for comparison.

1.05 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

1.06 OPTIONS

- A. Contractors may, at their option, substitute:
 - 1. Power-driven Fasteners in lieu of Anchor Bolts at Interior Non-Structural Stud Wall Base Plates as follows:
 - a. Manufacturer and Type:Hilti DN 72, NK72 or approved.
 - b. Maximum spacing at Non-load Bearing Walls: 24 inches, 6 inches minimum, 12 inches maximum from ends.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. Species: Douglas Fir-Larch, unless otherwise indicated.
 - 2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
- B. Provide wood harvested and milled within 500 miles of the project site.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Grading Agency: Western Wood Products Association; WWPA G-5.
- B. Sizes: Nominal sizes as indicated on drawings, S4S.
- C. Moisture Content: S-dry or MC19.
- D. Stud Framing (2 by 2 through 2 by 6):
 - 1. Species and Grade: As indicated on Structural Drawings.
- E. Joist, Rafter, and Small Beam Framing (2 by 6 through 4 by 16):1. Species and Grade: As indicated on Structural Drawings.
- F. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, No. 2 or Standard Grade.
 - 2. Boards: Standard or No. 3.
 - 3. Species and Grade: As indicated on Structural Drawings.

2.03 STRUCTURAL COMPOSITE LUMBER

- A. At Contractor's option, structural composite lumber may be substituted for concealed dimension lumber and timbers with approval from Architect/Engineer.
- B. Structural Composite Lumber: Factory fabricated beams, headers, and columns, of sizes and types indicated on drawings; structural capacity as published by manufacturer.
- C. Manufacturers:
 - 1. Weyerhaeuser Company: www.weyerhaeuser.com/#sle.
 - 2. Substitutions: See Section 01 6000 Product Requirements.
- D. Laminated Veneer Lumber "LVL"
 - 1. Material: ICBO approved.
 - a. Shear Modulus of Elasticity (G): 125,000 psi.

- b. Modulus of Elasticity (E): 2,000,000 psi.
- c. Flexural Stress (Fb): 2600 psi.
- d. Compression Perpendicular to Grain, Parallel to Glue Line (Fc): 750 psi.
- e. Compression Parallel to Grain (Fc): 2,510 psi.
- f. Horizontal Shear (Fv): 285 psi.
- 2. Model: Similar to "1 3/4" 2.0E WS Micro-Lam LVL" by Trus Joist/Weyerhaeuser.
- 3. Fabrication: In accordance with CABO Report No. NER-126.
- 4. Size: As shown on drawings and to meet load and span conditions.
- E. Laminated Strand Lumber "LSL"
 - 1. Material:
 - a. Modulus of Elasticity (E): 1,550,000 psi.
 - b. Flexural Stress (Fb): 2325 psi.
 - c. Compression Perpendicular to Grain (Fc): 900 psi.
 - d. Compression Parallel to Grain (Fc): 2170 psi.
 - e. Horizontal Shear (Fv): 310 psi.
 - 2. Model: Similar to "Timberstrand LSL 1.55E" by Trus Joist/Weyerhaeuser.
 - 3. Fabrication: In accordance with CABO Report No. NER-126.
 - 4. Size: As shown on drawings and to meet load and span conditions.
- F. Parallel Strand Lumber "PSL"
 - 1. Material:
 - a. Modulus of Elasticity (E): 2,000,000 psi.
 - b. Flexural Stress (Fb): 2900 psi.
 - c. Compression Perpendicular to Grain (Fc): 625 psi.
 - d. Compression Parallel to Grain (Fc): 2900 psi.
 - e. Horizontal Shear (Fv): 290 psi.
 - 2. Model: Similar to "Parallam" by Trus Joist/Weyerhaeuser.
 - 3. Fabrication: In accordance with CABO Report No. NER-126.
 - 4. Size: As shown on drawings and to meet load and span conditions.

2.04 CONSTRUCTION PANELS

- A. Subfloor/Underlayment Combination: PS 2 type, rated Single Floor.
 - 1. Bond Classification: Exterior.
 - 2. Span Rating: 48.
 - 3. Performance Category: 1-1/8 PERF CAT.
 - 4. Thickness: As indicated on drawings.
 - 5. Panel Size: 48 x 96 inches.
 - 6. Edges: Tongue and groove.
- B. Underlayment: APA Underlayment; plywood, Exposure 2, 1/2 inch thick. Fully sanded faces at resilient flooring.
- C. Roof Sheathing: See Structural Drawings.
- D. Wall Sheathing: See Structural Drawings.
- E. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.05 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
 - 2. Machine Bolts, Nuts, Washers, and Screws: Conforming to ASTM A307, galvanized where exposed.
 - 3. Lag Bolts and Wood Screws: ANSI/ASME B18.6.1-1981, zinc plated.
 - 4. Threaded Rods: ASTM A36 or ASTM A307.

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- 5. Anchor Bolts: ASTM A 307, Grade C.
- 6. Washers: Provide Hot-dip Galvanized Steel Washers under Bolt Heads, Lag Heads, and Nuts adjacent to all wood framing members.
- 7. Epoxy Anchors: Hilti HIT HY-150 Max (at CMU); Hilti HIT-RE 500 SD (at concrete), or approved.
- 8. Powder Actuated Fasteners:
 - a. To Steel: "DS with Washer", by Hilti, "Power Point with Washer", by Ramset/Redhead, or approved.
 - b. To Concrete (non-seismic applications only): "DN72 with Washer", by Hilti, or approved.
 - c. To Concrete Masonry (non-seismic applications only): "DXE72 with Washer", by Hilti, or approved.
- 9. Self-drilling screws of wood-to-wood connections: Simpson SDS series or approved.
- 10. Self-drilling screws to light-gage framing: Traxx by ITW Buildex or approved; with break-off wings, flat or bugle head.
- B. Framing Connectors: Zinc-coated steel; Simpson, or approved. Connector model numbers shown on Drawings are taken from Simpson Catalog. If specific type is not shown on Drawings, use type recommended by Manufacturer for conditions of installation.
- C. Joist Hangers: Hot dipped galvanized steel, sized to suit framing conditions.
 - 1. For contact with preservative treated wood in exposed locations, provide minimum G185 galvanizing complying with ASTM A653/A653M.
- D. Sill Gasket on Top of Foundation Wall: 1/4 inch thick, plate width, closed cell plastic foam from continuous rolls.
- E. Subfloor Adhesives: Waterproof, air cure type, cartridge dispensed; adhesives designed for subfloor applications and complying with either ASTM C557 or ASTM D3498.

2.06 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
 - 1. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

PART 3 EXECUTION

3.01 PREPARATION

- A. Install sill gasket under sill plate of framed walls bearing on foundations; puncture gasket cleanly to fit tightly around protruding anchor bolts.
- B. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 FRAMING INSTALLATION

- A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.
- B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.

- C. Install structural members full length without splices unless otherwise specifically detailed.
- D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AWC (WFCM) Wood Frame Construction Manual.
- E. Install horizontal spanning members with crown edge up and not less than 1-1/2 inches of bearing at each end.
- F. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise detailed. Space to provide clearance for pipes in partitions.
- G. Provide bridging at joists in excess of 8 feet span as detailed. Do not anchor until Dead Loads are in place. Space bridging members 1/4 inch apart to avoid members rubbing against each other. Fit solid blocking at ends of members.
- H. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.
- I. Do not notch, bore, or drill framing members except as noted on Drawings, or as approved by Engineer.
- J. Do not install composite lumber in contact with concrete. Provide treated dimension lumber for plates in contact with foundations.
- K. Provide preservative-treated wood nailers on roof deck as indicated on Drawings or as required by membrane roofing manufacturer.
 - 1. Coordinate thickness of nailer with thickness of roof insulation.

3.04 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. 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.
- 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.

3.05 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

3.06 INSTALLATION OF CONSTRUCTION PANELS

- A. Subflooring/Underlayment Combination: Glue and nail to framing; staples are not permitted.
- B. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing. See Structural Drawings.
 - 1. At long edges provide solid blocking where joints occur between roof framing members and as indicated in the Structural Drawings.
 - 2. Nail panels to framing; staples are not permitted.
- C. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using fasteners as indicated on Drawings.
 - 1. Block unsupported edges at shearwalls as shown on Drawings.
 - 2. Drive sheathing fasteners flush with panel face, do not overdrive.

- D. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
 - 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
 - 2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
 - 3. Install adjacent boards without gaps.
 - 4. Size and Location: As indicated on drawings.
- E. Install panels with a minimum 1/16 inch, maximum 1/8 inch gap between adjoining panels.

3.07 ACCESSORIES AND FASTENER INSTALLATION

- A. Provide Framing Connectors where indicated; secure with fasteners recommended by manufacturer to achieve maximum load capacity.
- B. Provide Washers under Nuts and Heads when making Bolted or Lag Screwed connections.
- C. Drive Nails perpendicular to Grain in lieu of toe-nailing where feasible.
- D. Lag Screws: Pre-drill to 70% of the shank diameter in supporting member, 1/32 to 1/16 inch larger than shank diameter in attached members. Use standard cut washer between bolt head and wood. Install Lag Screws by turning, do not drive with hammer.
- E. Nails and Screws: Fasten members as shown on Drawings. Predrill holes as required to prevent splitting of members. Nailed connections not shown on Drawings or specified by manufacturer shall conform to the building code.
- F. Bolts: Set in holes 1/32 inch to 1/16 inch larger than bolt through wood member. Tighten to snug position. Use cut washer between nut or bolt head and wood.
- G. Powder-Driven Connectors: Select size and type for full penetration into substrate without splitting connected wood members or fracturing substrate. Use washer under head to prevent over-driving.

3.08 SITE APPLIED WOOD TREATMENT

- A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.
- B. Allow preservative to dry prior to erecting members.

3.09 TOLERANCES

- A. Framing Members: 1/4 inch from true position, maximum.
- B. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

SECTION 06 1733 WOOD I-JOISTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wood I-joists for roof and floor framing.
- B. Bridging, bracing, and anchorage.
- C. Framing for openings.

1.02 RELATED REQUIREMENTS

- A. Section 01 6116 Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 06 1000 Rough Carpentry: Installation requirements for miscellaneous framing.

1.03 REFERENCE STANDARDS

- A. ASTM D5055 Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists; 2019, with Editorial Revision (2020).
- B. PS 1 Structural Plywood; 2009 (Revised 2019).

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's literature describing materials, dimensions, allowable spans and spacings, bearing and anchor details, bridging and bracing requirements, and installation instructions; identify independent inspection agency.
- C. Shop Drawings: Indicate sizes and spacing of joists, bracing and bridging, bearing stiffeners, holes to be cut (if any), and framed openings between joists.
- D. Certificate: Certification by joist manufacturer that products delivered are of the same design and construction as those evaluated by the independent inspection agency.

1.05 QUALITY ASSURANCE

1.06 SUBSTITUTIONS

- A. To be eligible for Substitution Approval, Alternate Systems from that specified must maintain same overall depth, and provide equally simple installation methods and application of adjacent materials to Chord Members.
- B. In accordance with Section 01 6000, Accompany Requests For Substitution approval with complete data on Metal Connectors and other Hardware Items, as well as Affidavit, bearing Oregon Seal of Registered Structural Engineer, that proposed System conforms with Design Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in manufacturer's original packaging with manufacturer's name and product identification intact and legible.
- B. Protect products from damage due to weather and breakage.
- C. Protect joists from warping or other distortion by stacking in upright position, braced to resist movement, with air circulation under coverings and around stacks.
- D. Handle individual joists in the upright position.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Wood I-Joists:
 - 1. Project is designed around the BCI/Boise Cascade Western product line.

- 2. The following manufacturers are approved provided that they can provide the specified plywood web joists with the same span and load carrying requirements at the same depth as shown on drawings:
 - a. Louisiana-Pacific Corporation: www.lpcorp.com.
 - b. Weyerhaeuser Company: www.weyerhaeuser.com.
 - c. Substitutions: See Section 01 6000 Product Requirements.

2.02 MATERIALS

- A. Wood I-Joists: Laminated veneer lumber top and bottom flanges and plywood webs bonded together with structural adhesive, with published span rating to meet project requirements.
 - 1. Span Rating: Established and monitored in accordance with ASTM D5055 by independent inspection agency.
 - 2. Plywood/OSB: Comply with PS 1.
 - 3. Adhesive: Tested for wet/exterior service in accordance with ASTM D2559.
 - 4. Depth: As indicated on drawings.
 - 5. Fabrication Tolerances:
 - a. Flange Width: Plus/minus 1/32 inch.
 - b. Flange Thickness: Minus 1/16 inch.
 - c. Joist Depth: Plus 0, minus 1/8 inch.
 - 6. Marking: Mark each piece with depth, joist spacing, and allowable span for joist spacing.
 - 7. Provide bearing stiffeners if required by span rating or joist hanger manufacturer.
- B. Wood-Based Components:
 - 1. Wood fabricated from old growth timber is not permitted.
- C. Joist Hangers: Simpson Strong-Tie, or approved..
- D. Joist Bridging: Type, size and spacing recommended by joist manufacturer.
- E. Wood Blocking, Plates, and Miscellaneous Framing: Softwood lumber, Douglas fir, construction grade, maximum moisture content of 19 percent. Provide as shown on drawings and required for complete installation of I-Joists.
- F. Fasteners: Electrogalvanized steel, type to suit application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that supports and openings are ready to receive joists.

3.02 PREPARATION

A. Coordinate placement of bearing items.

3.03 ERECTION

- A. Install joists in accordance with manufacturer's instructions.
- B. Set structural members level and plumb, in correct position.
- C. Make provisions for erection loads and for sufficient temporary bracing to maintain structure plumb and in true alignment until completion of erection and installation of permanent bracing.
- D. Do not field cut or alter structural members without approval of Architect.
- E. Install permanent bridging and bracing.
- F. Install headers and supports to frame openings required.
- G. Frame openings between joists with lumber in accordance with Section 06 1000.
- H. Provide necessary Blocking, Bridging, Bearing Plates, Web Stiffeners, End, Supports, Anchoring Clips, Fasteners, and Bracing required for a complete installation.

3.04 TOLERANCES

A. Framing Members: 1/4 inch maximum, from true position.

SECTION 06 1800 GLUED-LAMINATED CONSTRUCTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Glue laminated wood beams and purlins.
- B. Glue laminated wood beams for stair treads and benches.

1.02 RELATED REQUIREMENTS

- A. Section 01 6116 Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 05 5100 Metal Stairs
- C. Section 06 1000 Rough Carpentry
- D. Section 06 1733 Wood I-Joists
- E. Section 09 9000 Painting and Coating

1.03 REFERENCE STANDARDS

- A. AITC A190.1 American National Standard for Wood Products Structural Glued Laminated Timber; 2007.
- B. ASTM D2559 Standard Specification for Adhesives for Bonded Structural Wood Products for Use Under Exterior Exposure Conditions; 2012a (Reapproved 2018).
- C. RIS (GR) Standard Specifications for Grades of California Redwood Lumber; 2019.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate framing member grade, sizes, lengths, and cambers.
- C. AITC Certificate of Conformance with attachments 1 and 2, stating that glued-laminated units conform to these specifications.

1.05 QUALITY ASSURANCE

A. Manufacturer/Fabricator Qualifications: Company specializing in manufacture of glue laminated structural units with three years of documented experience, and certified by AITC in accordance with AITC A190.1.

PART 2 PRODUCTS

2.01 GLUED-LAMINATED UNITS

- A. Glued-Laminated Units: Fabricate in accordance with AITC 117 Industrial and Premium. grade.
 - 1. Verify dimensions and site conditions prior to fabrication.
 - 2. Cut and fit members accurately to length to achieve tight joint fit.
 - 3. Fabricate member with camber built in.
 - 4. Do not splice or join members in locations other than those indicated without permission.
 - 5. After end trimming, seal with penetrating sealer in accordance with AITC requirements.

2.02 MATERIALS

- A. Lumber: Softwood lumber complying with RIS (GR) grading rules with 12 percent maximum moisture content before fabrication. Design for the following values:
 - 1. Grade:
 - a. At Beams: AITC Industrial Grade where concealed from view.
 - b. At Stair treads and benches: Premium grade Glu-lams, fill voids with epoxy filler.
 - 2. Structural units shall meet the requirements of 24F-V4 for simply supported beams, and 24F-V8 for beams continuous across supports or cantilevered. All DF/DF.
 - 3. Bending (Fbx+): 2,400 psi.

- 4. Bending (Fbx-): 2,400 psi or 1,850 psi, depending on designation. See Structural Drawings.
- 5. Compression Parallel to Grain (Fc): 1,100 psi.
- 6. Compression Perpendicular to Grain Top (Fc1): 650 psi.
- 7. Horizontal Shear (Fv): 265 psi.
- 8. Modulus of Elasticity (E): 1,800,000 psi.
- 9. Lumber fabricated from old growth timber is not permitted.
- 10. Provide lumber harvested within a 500 mile radius of the project site.
- B. Laminating Adhesive: Tested for wet/exterior service in accordance with ASTM D 2559.

2.03 FABRICATION

- A. Fabricate glue laminated structural members in accordance with AITC Industrial and Premium grade.
- B. Cut and fit members accurately to length to achieve tight joint fit.
- C. Fabricate member with camber built in.
- D. Do not splice or join members in locations other than those indicated without permission.
- E. After end trimming, seal with penetrating sealer in accordance with AITC requirements.
- F. Affix AITC Stamp of Specification Conformance on each member.
- G. Appearance:
 - 1. At Beams:
 - a. AITC Industrial Grade where concealed from view.
 - 2. At exposed stair treads and benches, Epoxy filler to match color of lamination in their finished, stained appearance.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that supports are ready to receive units.

3.02 PREPARATION

A. Coordinate placement of bearing items.

3.03 ERECTION

- A. Lift members using protective straps to prevent visible damage.
- B. Set structural members level and plumb, in correct positions or sloped where indicated.

3.04 TOLERANCES

A. Framing Members: 1/2 inch maximum from true position.
SECTION 06 2000 FINISH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Interior and exterior finish carpentry items, including running trim and panel material.
- B. Hardware and attachment accessories.

1.02 RELATED REQUIREMENTS

- A. Section 01 6116 Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 05 5100 Metal Stairs
- C. Section 06 1000 Rough Carpentry: Support framing, grounds, and concealed blocking.
- D. Section 06 4100 Architectural Wood Casework: Shop fabricated custom cabinet work.
- E. Section 09 9000 Painting and Coating: Painting of finish carpentry items

1.03 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) Architectural Woodwork Standards; 2014, with Errata (2018).
- B. AWMAC/WI (NAAWS) North American Architectural Woodwork Standards, U.S. Version 3.1; 2017, with Errata (2019).

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with plumbing rough-in, electrical rough-in, and installation of associated and adjacent components.
- B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements for submittal procedures.
- 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. Provide the information required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
- D. Samples: Submit two samples of finish plywood, <u>by</u> inch in size illustrating wood grain and specified finish.
- E. Samples: Submit two samples of wood trim 12 inch long.

1.06 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

1.07 MOCK-UP

- A. Guardrail Top Cap:
 - 1. Provide one mock-up for each trim type. Mock up to include at least two pieces of material, at least one joint of every major type, and each type of fastener..
 - 2. Locate where directed.
 - 3. Mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Protect from moisture damage.
- B. Protect material from discoloration due to uneven exposure to light.

PART 2 PRODUCTS

2.01 FINISH CARPENTRY ITEMS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Surface Burning Characteristics: Provide materials having fire and smoke properties as required by applicable code.

2.02 LUMBER MATERIALS

- A. Interior Hardwood Trim: White Maple species; PS 20, AWI Premium Grade; plain sawn, smooth texture; mixed grain; maximum moisture content of 6 percent; suitable for clear finish.
 - 1. Ease exposed edges with 1/16 inch radius, unless otherwise shown.
 - 2. Minimum lengths: Opening & Standing Trim: 1 piece, single length. Running Trim: Joints minimum 12 feet apart.
 - 3. Extent of Work:

2.03 SHEET MATERIALS

- A. Medium Density Fiberboard (MDF): Industrial Grade engineered wood-based panel, water resistant, manufactured with a formaldehyde-free binder and which meets the requirements of ANSI A208.2-1994, product class MD-EXTERIOR.
 - 1. Manufacturer and Brand: Medex, by Sierrapine, or approved.

2.04 FASTENINGS

A. Fasteners: Of size and type to suit application.

2.05 ACCESSORIES

A. Wood Filler: Solvent base, tinted to match surface finish color.

2.06 FABRICATION

- A. Shop assemble work for delivery to site, permitting passage through building openings.
- B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.02 INSTALLATION

- A. Install custom fabrications in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
- B. Set and secure materials and components in place, plumb and level.
- C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.
- D. Miter corners.
- E. Use concealed fasteners wherever possible, unless noted otherwise on Drawings.
- F. At fasteners installed through the exposed surface(s) of the trim, countersink and/or set fasteners low enough to accommodate wood plugs or wood filler.
- G. Ease sharp external corners prior to finishing.
- H. At Interior Wall Panels vertical panel edges, ease edge with 1/8 inch chamfer.
 - 1. Vertical panel edges, ease edge with 1/8 inch chamfer.

- 2. At outside corners, provide 1 inch by 1 inch Interior Painted Wood trim as shown on drawings.
- I. At Hardwood Veneer Plywood Panels, install with Attachment Clips as shown on the Drawings.
- J. Install wall panels with exposed screws spaced as shown on drawings

3.03 PREPARATION FOR SITE FINISHING

A. Set exposed fasteners. Apply wood filler in exposed fastener indentations less than 1/4 inch in diameter, and wood plugs in indentations 1/4 inch or greater. Sand work smooth.

SECTION 06 4100 ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Specially fabricated cabinet units.
- B. Hardware.
- C. Factory finishing.
- D. Preparation for installing utilities.

1.02 RELATED REQUIREMENTS

- A. Section 01 6116 Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 06 1000 Rough Carpentry: Support framing, grounds, and concealed blocking.
- C. Section 12 3600 Countertops.
- D. Division 26 5000 Lighting: Under-counter lights

1.03 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) Architectural Woodwork Standards; 2014, with Errata (2018).
- B. AWI/AWMAC/WI (AWS) Architectural Woodwork Standards; 2014, with Errata (2018).
- C. HPVA HP-1 American National Standard for Hardwood and Decorative Plywood; 2016.
- D. NEMA LD 3 High-Pressure Decorative Laminates; 2005.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles & elevations, fastening methods, jointing details, connections to adjacent work, schedule of finishes, and accessories.
- C. Product Data: Provide data for panel products and hardware accessories.
- D. Samples:
 - 1. Submit 1 sample of each plastic laminate color specified, 4 inch x 5 inch size.
 - 2. Submit 1 sample of each plastic laminate edge banding, 12 inches long.
- E. Samples: Submit actual sample items of proposed pulls, hinges, locksets, and drawer slides, demonstrating hardware design, quality, and finish.
- F. Resubmitted of Shop Drawings: If field measurements result in significant changes to the casework design, resubmit all shop drawings after field dimensions have been verified.
 - 1. Indicate on resubmitted drawings all dimensions which were verified.
 - 2. Indicate significant changes to casework resulting from field-measured conditions. Do not proceed with fabrication until approved by Architect.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from moisture damage.
- B. Do not deliver casework to jobsite until notified by General Contractor that Project is conditioned and prepared to handle and store casework without damage or discoloration.

1.07 FIELD CONDITIONS

A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 CABINETS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Cabinets:
 - 1. Finish Exposed Exterior Surfaces: Decorative laminate.
 - 2. Finish Exposed Interior Surfaces: Decorative laminate.
 - 3. Finish Semi-Exposed Surfaces: Decorative laminate
 - 4. Finish Concealed Surfaces: Manufacturer's option.
 - 5. Door and Drawer Front Edge Profiles: Square edge with thin applied band.
 - 6. Casework Construction Type: Type A Frameless.
 - 7. Casework panel substrate: 3/4 inch Interior MDF or Particleboard.

2.02 WOOD-BASED COMPONENTS

- A. Wood fabricated from old growth timber is not permitted.
- B. Exterior Medium Density Fiberboard (Ex-MDF): Industrial Grade engineered wood-based panel, water resistant, manufactured with a formaldehyde-free binder and which meets the requirements of ANSI A208.2, product class MD-EXTERIOR.
 - 1. Manufacturer and Brand: Medex, by Sierrapine, or approved equal.
- C. Interior Medium Density Fiberboard (MDF): Industrial Grade engineered wood-based panel, water resistant, manufactured with a formaldehyde-free binder and which meets the requirements of ANSI A208.2 product class MD.
 - 1. Manufacturer and Brand: Medite II, by Sierrapine, or approved equal.
- D. Particle Board: Engineered composite panel wood product made from 100 percent pre-consumer and reclaimed Ponderosa Pine and species of western wood particles, and no added urea-formaldehyde.
 - 1. Moisture Content: 7 percent
 - 2. Minimum Density 45.0 lb/cu ft
 - 3. Sanding: 100 grit
 - 4. Surface Strength: 350 psi
 - 5. Manufacturers:
 - a. Boise Cascade "Boise Evergreen".
 - b. Roseburg "Skyblend".
 - c. Approved equal.
- E. Hardboard: AHA A135.4; Pressed wood fiber with resin binder, Class 1 Tempered, 1/4 inch thick, smooth two sides (S2S); use for drawer bottoms, dust panels, and other components indicated on drawings.
 - 1. Provide prefinished hardboard for cabinet drawer bottoms.

2.03 LAMINATE MATERIALS

- A. Manufacturers:
 - 1. Formica Corporation: www.formica.com.
 - 2. Panolam Industries International, Inc; Nevamar: www.nevamar.com.
 - 3. Wilsonart LLC: www.wilsonart.com/#sle.
 - 4. Substitutions: See Section 01 6000 Product Requirements.
- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
- C. Provide specific types as indicated.
 - 1. Horizontal Surfaces: HGS, 0.048 inch nominal thickness, through color, colors as indicated, finish as indicated.
 - 2. Vertical Surfaces: VGS, 0.028 inch nominal thickness, through color, colors as indicated, finish as indicated.

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- 3. Cabinet Liner: CLS, 0.020 inch nominal thickness, through color, colors as indicated, finish as indicated.
- 4. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.04 COUNTERTOPS

A. Countertops are specified in Section 12 3600.

2.05 ACCESSORIES

- A. Adhesive: Type recommended by fabricator to suit application.
- B. Plastic Edge Banding: Extruded PVC, convex shaped; smooth finish; of width to match component thickness.
 - 1. Color: To match adjacent plastic laminate color.
 - 2. Use 3 mm at all exposed edges, doors and drawer fronts, vertical case ends, bottoms and sub-tops.
 - 3. Use 3 mm at all exposed shelf edges.
- C. Fasteners: Size and type to suit application.
- D. Door Silencers: Felt or rubber to prevent noisy door to frame contact.
- E. Provide clear rubber cabinet door bumpers at locations where cabinet doors or pulls hit adjacent walls, window sills, or other building elements.
- F. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
- G. Concealed Joint Fasteners: Threaded steel.

2.06 HARDWARE

- A. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch spacing adjustments.
- B. Fixed Americans with Disabilities Act (ADA)-Compliant Vanity and Countertop Brackets:
 - 1. Material: Steel.
 - 2. Color: Selected by Architect from manufacturer's standard range.
 - 3. Products:
 - a. A&M Hardware, Inc ; ADA Vanity Brackets: http://www.aandmhardware.com/#sle.
 - b. Rakks/Rangine Corporation; ADA Compliant Rakks EHV Vanity Supports: www.rakks.com/#sle.
 - c. RPC Rockford Process Control, Inc; Vanity Brackets.
 - d. Substitutions: See Section 01 6000 Product Requirements.
- C. Drawer and Door Rod Pulls: Steel rod pull, stainless steel look.
 - 1. Product: DP57B manufactured by Mockett.
- D. Cabinet Locks: Keyed cylinder, two keys per lock, each room different and, master keyed, steel with satin finish. Locate where shown on drawings. Provide with standard or custom-fabricated strike plate to fit the style of casework detailed.
 - 1. Manufacturers:
 - a. National Lock
 - b. Russwin
 - c. Yale
- E. Drawer Slides:
 - 1. Type: Full extension.
 - 2. Static Load Capacity: Heavy Duty grade.
 - 3. Mounting: Side mounted.
 - 4. Stops: Integral type.

- F. Hinges: European style concealed self-closing type, 170 degree opening angle ,steel with satin finish.
 - 1. Available Products:
 - a. Julius Blum, Inc: www.blum.com
 - b. Substitutions: See Section 01 60 00 Product Requirements.
- G. Countertop Supports:
 - 1. Type-1:
 - a. Federal Brace, Versa Hidden Support Bracket, 18"x2"x18", Black.
 - b. Federal Brace ADA Universal Floating Vanity Bracket, 20"x1.65"x20", Black
 - c. Federal Brace Freedom Hidden Countertop Bracket, 8"x2"x8", Black

2.07 FABRICATION

- A. Laminate Finished Surface Definitions: Comply with requirements of AWI/AWMAC Architectural Woodwork Quality Standards Illustrated and the following:
 - 1. Exposed portions of casework include all surfaces visible when doors and drawers are closed, interior faces of cabinet doors and exposed surfaces of open cases including top and bottom of shelving, interior cabinet surfaces visible behind glass doors.
 - 2. Semi-exposed surfaces of casework include those members behind opaque doors such as shelves, drawers, dividers, interior faces of ends, case backs and backs and bottoms.
 - 3. Concealed portions of casework include sleepers, dust panels, and other surfaces not visible after installation.
- B. Drawer Construction Technique: Lock shoulder joints.
- C. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- D. Construct cabinets without integral base. Provide separate structural base as specified below.
- E. Cabinet Backs: Provide minimum 1/2-inch thick cabinet back. Where back of cabinet is exposed to view, provide 3/4-inch plywood with high pressure laminate facing
- F. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- G. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- H. Base Construction: Construct cabinet bases of 3/4-inch thick marine grade plywood, glued and screwed. Provide reinforcing blocks as required for maximum strength. Recess base for toe space as indicated. Set base on floor where casework is to be installed. Level top surface and scribe bottom surface to floor line leaving a height of 4-inches between floor and bottom of casework.
- I. Drawers:
 - 1. Fronts: One piece 3/4-inch thick, plywood with 3 mm plastic edge facing on all four sides.
 - 2. Sides: 1/2-inch thick medium density overlay plywood.
 - 3. Back and Sub-Front: 3/4-inch thick plywood.
 - 4. Edge band top edges of sides, backs and sub-front.
 - 5. Bottoms: Minimum 1/2-inch plywood or 1/4-inch hardboard set into 1/4-inch deep grooves at front, back and both sides
 - 6. Drawer Reinforcement: Reinforce drawer bottoms in excess of 400 square inches in area with 1 inch by 3 inch wood strip running front to back centered on drawer.
 - 7. Fabricate drawers full depth of cabinet.
 - 8. Mount drawers with positive in and out stops.
- J. Cabinet Doors: Plastic laminate clad 3/4-inch thick plywood or MDF with 3 mm plastic edge facing on all edges.
 - 1. Provide hinges in the following quantities:
 - a. Two hinges for doors up to 36 inches high, 24 inches wide.

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- b. Three hinges for doors up to 48 inches high, 24 inches wide.
- c. Four hinges for doors up to 82 inches high, 24 inches wide.
- d. For doors in excess of dimension indicated above, comply with hinge manufacturer's recommendations for size and weight of door.
- 2. Surface apply hinges, do not let-in hinges.
- K. Semi-Exposed Cabinet Shelving: Provide plastic laminate clad plywood or MDF as follows:
 - 1. 3/4-inch thick plywood for shelving less than 32 inches wide.
 - 2. 1-inch thick plywood for shelving more than 32 inches wide.
 - 3. Provide "Line Bored" multi-hole shelf support holes.
 - 4. Allow 1/16-inch clearance at each end of loose shelving (1/8-inch overall) for ease of moving shelves.
 - 5. Cover all edges of shelving with plastic edging matching surface of shelves.
- L. Filler Panels: Provide filler panels covered with matching plastic laminate to fill in all voids between cabinets and walls, including the full depth at underside of upper cabinets.
- M. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
 - 1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
 - 2. Cap exposed plastic laminate finish edges with material of same finish and pattern.
- N. Provide cutouts for plumbing fixtures, appliances, and and other built-in items. Verify locations of cutouts from on-site dimensions. Seal cut edges.
- O. All shelves shall be adjustable, unless required to be fixed in place for the stability of the casework, or as otherwise noted on the drawings.
- P. Provide square cut outs in cabinet doors where shown on drawings. Fabricate cut outs with smooth edges slightly eased. Cleanly cut inside corners.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

- A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
- B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- C. Use concealed joint fasteners to align and secure adjoining cabinet units.
- D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
- E. Secure cabinets to floor using appropriate angles and anchorages.
- F. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.03 ADJUSTING

- A. Adjust installed work.
- B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

SECTION 06 8205 FIBERGLASS REINFORCED PLASTIC PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fiberglass reinforced polyester panel system for adhesive mounting.
- B. Moldings, adhesive, and joint sealants.

1.02 RELATED SECTIONS

1.03 REFERENCES

- A. ASTM D 523 Standard Test Method for Specular Gloss; 1989 (Reapproved 1999).
- B. ASTM D 570 Standard Test Method for Water Absorption of Plastics; 1998.
- C. ASTM D 638 Standard Test Method for Tensile Properties of Plastics; 2003.
- D. SCAQMD 1168 South Coast Air Quality Management District Rule No.1168; current edition; www.aqmd.gov.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- 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.
- C. Selection Samples: For each finish specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- D. Maintenance Instructions.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.06 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Marlite "FRP Panels"
 - 2. Sequentia "Structoglas"
 - 3. Crane "Kemlite Glasboard-P with Surfaseal" : www.frpdesignsolutions.com
- B. Substitutions: See Section 01 6000 Product Requirements.

2.02 PANEL SYSTEM

- A. Plastic Panel System: Factory finished panels, trim, sealant, and accessories.
- B. Backing: Water Resistant and Standard Gypsum Board Specified in Section 09260
- C. Surface Pattern: Smooth
- D. Color: See Color Schedule.
- E. Primers, Sealers, and Adhesives: Water-resistant type recommended by manufacturer.
- F. Joint Sealant: Clear translucent silicone.

- G. Trim and Accessories: Provide all One and Two Piece Vinyl Moldings and Nylon Drive Rivets for a complete moisture resistant installation.
 - 1. Provide typical Division Bar, Inside Corner, Outside Corner, and End Caps.
- H. Thickness: 3/32 inch, nominal.
- I. Width: 48 inches.
- J. Height: 96 inches.

2.03 ACCESSORIES

- A. Primers, Adhesives, and Seaming Materials: Waterproof; types recommended by flooring manufacturer.
 - 1. Provide only products having lower volatile organic compound (VOC) content than required by the more stringent of the South Coast Air Quality Management District Rule No.1168 and the Bay Area Air Quality Management District Regulation 8, Rule 51.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. Verify that Surfaces to receive Paneling are accurately sized and located, dry, clean, smooth, sound, secure, free from conditions that would damage Paneling, impair adhesive-bond, or mar Paneling finished appearance, and are otherwise properly prepared.
- C. If substrate preparation is the responsibility of another installer, notify General Contractor of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Take panels out of cartons and allow to acclimatize to room conditions for at least 48 hours 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. Clean surfaces thoroughly prior to installation.
- D. Protect existing surfaces from damage due to installation.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Use the adhesives recommended by the panel manufacturer unless prohibited by local regulations; obtain manufacturer's approval of alternative adhesives.
- C. Install continuous bead of silicone sealant in each joint and trim groove and between trim and adjacent construction, maintaining 1/8 inch expansion space.
- D. Avoid contamination of panel faces with adhesives, solvents, or cleaners; clean as necessary and replace if not possible to repair to original condition.
- E. Protect installed products until completion of project.
- F. Touch-up, repair or replace damaged products after Substantial Completion.

SECTION 07 1113 BITUMINOUS DAMPPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Bituminous dampproofing.
- B. Protection boards.

1.02 RELATED REQUIREMENTS

A. Section 07 2100 - Thermal Insulation: Rigid insulation board used as protection board.

1.03 REFERENCE STANDARDS

- A. ASTM D41/D41M Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing; 2011 (Reapproved 2016).
- B. ASTM D449/D449M Standard Specification for Asphalt Used in Dampproofing and Waterproofing; 2003, with Editorial Revision (2014).
- C. ASTM D4586/D4586M Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2018).

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide properties of primer, bitumen, and mastics.
- C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.05 QUALITY ASSURANCE

PART 2 PRODUCTS

2.01 MANUFACTURERS

2.02 BITUMINOUS DAMPPROOFING

- A. Bituminous Dampproofing: Cold-applied, trowel-grade; asphalt base, volatile petroleum solvents, and other content, suitable for application by trowel on vertical and horizontal surfaces.
 - 1. Composition: ASTM D4586/D4586M Type I, minimum, asbestos free.
 - 2. VOC Content: Not more than permitted by local, State, and federal regulations.
 - 3. Applied Thickness: 1/16 inch, minimum, wet film.
- B. Primers, Mastics, and Related Materials: Type as recommended by dampproofing manufacturer.

2.03 ACCESSORIES

A. Protection Board: Rigid insulation specified in Section 07 2100.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions are acceptable prior to starting this work.
- B. Verify substrate surfaces are durable, free of matter detrimental to adhesion or application of dampproofing system.
- C. Verify that items penetrating surfaces to receive dampproofing are securely installed.

3.02 PREPARATION

- A. Protect adjacent surfaces not designated to receive dampproofing.
- B. Clean and prepare surfaces to receive dampproofing in accordance with manufacturer's instructions.

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- C. Do not apply dampproofing to surfaces unacceptable to manufacturer.
- D. Apply mastic to seal penetrations, small cracks, or minor honeycombs in substrate.

3.03 APPLICATION

- A. Elevator Pit Walls: Apply two coats of asphalt dampproofing on soil side of pit walls prior to backfilling.
- B. Seal items watertight with mastic, that project through dampproofing surface.
- C. Place protection board directly over dampproofing, butt joints, and adhere to tacky dampproofing.
- D. Scribe and cut boards around projections, penetrations, and interruptions.

SECTION 07 2100 THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Board insulation at cavity wall construction, perimeter foundation wall, and at below-grade elevator pit walls.
- B. Batt insulation and vapor retarder in exterior wall construction.
- C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 RELATED REQUIREMENTS

- A. Section 04 2000 Unit Masonry: Coordination of Veneer Anchor layout with insulation.
- B. Section 06 1000 Rough Carpentry: Associated wood framing to support insulation.
- C. Section 07 2500 Weather Barriers: Separate air barrier and vapor retarder materials.
- D. Section 07 5400 Thermoplastic Membrane Roofing: Insulation specified as part of roofing system.
- E. Section 09 2116 Gypsum Board Assemblies: Acoustic insulation inside walls and partitions.

1.03 REFERENCE STANDARDS

- A. ASTM C423 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2017.
- B. ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2017.
- C. ASTM C553 Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
- D. ASTM C612 Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- E. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- F. ASTM E96/E96M Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- G. ASTM E136 Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C; 2019a.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- C. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.

1.05 QUALITY ASSURANCE

A. Air Barrier Association of America (ABAA) Evaluated Materials Program (EAP); www.airbarrier.org/#sle: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

1.06 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.01 APPLICATIONS

- A. Insulation at Perimeter of Foundation, and Elevator Pit walls: Mineral Wool Block board.
- B. Insulation Over Wood Stud Framed Walls, Continuous: Mineral Fiber board.
- C. Insulation in Wood Framed Walls: Batt insulation with separate vapor retarder.
- D. Insulation Over plywood Roof Deck: Specified in Section 07 5400 Thermoplastic Membrane Roofing.

2.02 FOAM BOARD INSULATION MATERIALS

2.03 FIBERBOARD INSULATION MATERIALS

- A. Mineral Wool Block and Board Thermal Insulation: Complying with ASTM C612.
 - 1. Facing: None, unfaced.
 - 2. Flame Spread Index: 25 or less, when tested with facing, if any, in accordance with ASTM E84.
 - 3. Smoke Developed Index: 50 or less, when tested with facing, if any, in accordance with ASTM E84.
 - 4. Board Size: 24" by 48" inches.
 - 5. Board Thickness: 2 inches.
 - 6. Thermal Resistance: R-value of 4.0 per inch at 75 degrees F, minimum, when tested according to ASTM C518.
 - 7. Products:
 - a. ROCKWOOL; COMFORTBOARD 110: www.rockwool.com/#sle.
 - 8. Substitutions: See Section 01 6000 Product Requirements.
 - 9. Extent of Work and R-value:
 - a. Slab edge / Foundation Walls: R-10, minimum.
 - b. Elevator Pit Walls: R-7.5, minimum.
- B. Mineral Fiberboard Insulation: Rigid or semi-rigid mineral fiber, ASTM C612 or ASTM C553; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
 - 1. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
 - 2. Board Thickness: 2 inches.
 - 3. Thermal Resistance: R-value of 4.0 per inch at 75 degrees F, minimum, when tested according to ASTM C518.
 - 4. Products:

5.

- a. ROCKWOOL; CAVITYROCK: www.rockwool.com.
- Substitutions: See Section 01 6000 Product Requirements.

2.04 BATT INSULATION MATERIALS

- A. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
 - 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 - 3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
 - 4. Formaldehyde Content: Zero.
 - 5. Facing: Unfaced.
 - 6. Products:
 - a. CertainTeed Corporation: www.certainteed.com/#sle.
 - b. Johns Manville: www.jm.com/#sle.
 - c. Knauf Insulation GmbH: www.knaufinsulation.us.
 - d. Owens Corning Corp: www.owenscorning.com.
 - 7. Substitutions: See Section 01 6000 Product Requirements.
 - 8. Extent of Work and R-Value:

a. Exterior Walls: R-21

2.05 INSULATION VAPOR RETARDERS

- A. Batt Insulation Vapor Retarder: Polyimide film vapor retarder that changes permeance with change in humidity; Certainteed MemBrain, or approved.
 - 1. Vapor Retarder Class: Class II.
 - 2. Water Vapor Permeance:
 - a. ASTM E 96, dry cup method: 1.0 perms (57ng/Pa*s*m2) or less.
 - b. ASTM E 96, wet cup method: 10.0 perms (1144ng/Pa*s*m2) or greater.
 - 3. Fire Hazard Classification: ASTM E 84:
 - a. Maximum Flame Spread Index: 20.
 - b. Maximum Smoke Developed Index: 55.
 - 4. Extent: Over thermal batt insulation at all walls.
 - 5. Manufacturers:
 - a. Certainteed Corporation: www.certainteed.com.
 - b. Substitutions: See Section 01 6000 Product Requirements.

2.06 FOAM SEALANT

- A. Provide one of the following:
 - 1. One-component, minimally expanding, low pressure-build, polyurethane foam sealant.
 - a. Locations of Use: At perimeter window and door shim spaces and crevices in exterior wall and roof.
 - b. Products: Great Stuff Pro.
 - 1) Substitutions: See Section 01 60 00 Product Requirements.
 - 2. Closed cell, medium density spray applied polyurethane foam insulation and air barrier.
 - a. Locations of Use: At perimeter window and door shim spaces and crevices in exterior wall and roof.
 - b. Products: BASF Walltite ECO v.2: www.walltite.com.
 - 1) Substitutions: See Section 01 60 00 Product Requirements.
- B. Foam insulation at voids or cavities in exterior wall or roof:
 - 1. Closed cell, medium density spray applied polyurethane foam insulation and air barrier.
 - a. Locations of Use: At voids and crevices in exterior wall and roof.
 - b. Products: BASF Walltite ECO v.2: www.walltite.com.
 - 1) Substitutions: See Section 01 60 00 Product Requirements.

2.07 ACCESSORIES

- A. Tape: Reinforced, self-adhesive tape approved by vapor retarder manufacturer for intended purpose.
 - 1. Width: As required for application
- B. Insulation Fasteners: Impaling clip of galvanized 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

3.01 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION AT FOUNDATION PERIMETER

- A. Apply adhesive to back of boards:
 - 1. Three continuous beads per board length.
 - 2. Full bed 1/8 inch thick.

- B. Install boards horizontally on foundation perimeter.
 - 1. Place boards to maximize adhesive contact.
 - 2. Install in running bond pattern.
 - 3. Butt edges and ends tightly to adjacent boards and to protrusions.
- C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.03 BATT INSTALLATION

- A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Install in exterior wall spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
- E. Install vapor retarder in continuous sheets over the inside face of all exterior wall surfaces and at bottom of batt ceiling insulation. Lap and seal sheet retarder joints over framing member face.
- F. Tape seal tears or cuts in vapor retarder.
- G. Extend vapor retarder tightly to full perimeter of adjacent window and door frames and other items interrupting the plane of the membrane. Tape seal in place.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

3.05 PROTECTION

A. Do not permit installed insulation or vapor barriers to be damaged prior to its concealment.

SECTION 07 2119 FOAMED-IN-PLACE INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Foamed-in-place insulation.
 - 1. In exterior framed walls.
 - 2. In exterior wall crevices.
 - 3. In exterior hollow-metal frames

1.02 REFERENCE STANDARDS

- A. ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2017.
- B. ASTM D1621 Standard Test Method for Compressive Properties Of Rigid Cellular Plastics; 2016.
- C. ASTM D2842 Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2019.
- D. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- E. ASTM E96/E96M Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- F. ASTM E2178 Standard Test Method for Air Permeance of Building Materials; 2013.

1.03 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product description, insulation properties, overcoat properties, and preparation requirements.
- C. Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of all contractor accreditation and installer certification on site during and after installation. Present on-site documentation upon request.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified, with minimum three years documented experience, and approved by manufacturer.

1.05 FIELD CONDITIONS

- A. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.
- B. Do not apply foam when temperature is within 5 degrees F of dew point.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Foamed-In-Place Insulation: Medium-density, rigid or semi-rigid, open or closed cell polyurethane foam; foamed on-site, using blowing agent of water or non-ozone-depleting gas.
 - 1. Thermal Resistance: R-value of 5.0, minimum, per 1 inch thickness at 75 degrees F mean temperature when tested in accordance with ASTM C518.
 - 2. Water Vapor Permeance: Vapor retarder; 2 perms, maximum, when tested at intended thickness in accordance with ASTM E96/E96M, desiccant method.
 - 3. Water Absorption: Less than 2 percent by volume, maximum, when tested in accordance with ASTM D2842.
 - 4. Air Permeance: 0.04 cfm per square foot, maximum, when tested at intended thickness in accordance with ASTM E2178 at 1.57 psf.
 - 5. Closed Cell Content: At least 90 percent.
 - 6. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify work within construction spaces or crevices is complete prior to insulation application.
- B. Verify that surfaces are clean, dry, and free of matter that may inhibit insulation or overcoat adhesion.

3.02 PREPARATION

- A. Mask and protect adjacent surfaces from over spray or dusting.
- B. Apply primer in accordance with manufacturer's instructions.

3.03 APPLICATION

- A. Apply insulation in accordance with manufacturer's instructions.
- B. Patch damaged areas.
- C. Where applied to voids and gaps assure space for expansion to avoid pressure on adjacent materials that may bind operable parts.
- D. Trim excess away for applied trim or remove as required for continuous sealant bead.

3.04 PROTECTION

A. Do not permit subsequent construction work to disturb applied insulation.

SECTION 07 2500 WEATHER BARRIERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Water-Resistive Barrier: Under exterior wall cladding, over sheathing or other substrate; not air tight or vapor retardant.
- B. Air Barriers: Materials that form a system to stop passage of air through exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls.
- C. Building envelope pre-installation meeting and mock up requirements.
- D. Rainscreen steel subgirts, Zee Subgirts, and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 Cast-in-Place Concrete: Vapor retarder under concrete slabs on grade.
- B. Section 06 1000 Rough Carpentry: Wood Sheathing substrate for Weather Barreir.
- C. Section 07 2100 Thermal Insulation: Vapor retarder installed in conjunction with batt or blown insulation.
- D. Section 07 6200 Sheet Metal Flashing and Trim: Metal flashings installed in conjunction with weather barriers.
- E. Section 07 9005 Joint Sealers: Sealant materials and installation techniques.

1.03 DEFINITIONS

- A. Weather Barrier: Assemblies that form either 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. Note: For the purposes of this specification, vapor impermeable air barriers are classified as vapor retarders.

1.04 REFERENCE STANDARDS

- A. AATCC Test Method 127 Water Resistance: Hydrostatic Pressure Test; 2018.
- B. ASTM D903 Standard Test Method for Peel or Stripping Strength of Adhesive Bonds; 1998 (Reapproved 2017).
- C. ASTM D1970/D1970M Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2019.
- D. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- E. ASTM E96/E96M Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- F. ASTM E2178 Standard Test Method for Air Permeance of Building Materials; 2013.
- G. ICC-ES AC38 Acceptance Criteria for Water-Resistive Barriers; 2016.
- H. ICC-ES AC148 Acceptance Criteria for Flexible Flashing Materials; 2017.

1.05 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on material characteristics, performance criteria, and limitations.
- C. Shop Drawings: Provide drawings of special joint conditions.
- D. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.
- E. Rainscreen Furring System Design:
 - 1. Provide documentation of proposed furring system.

1.06 QUALITY ASSURANCE

A. Air Barrier Association of America (ABAA) Evaluated Materials Program (EAP); www.airbarrier.org/#sle: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture, and use secondary materials approved in writing by primary material manufacturer.

1.07 PRE-INSTALLATION MEETING

- A. Hold a pre-installation conference, one week prior to start of weather barrier installation. Attendees shall include General Contractor, Architect, Weather Barrier Installer, Sheet Metal Installer, Owner's Representative, and Weather Barrier Manufacturer's Designated Representative.
- B. Review all related project requirements and submittals, status of substrate work and preparation, areas of potential conflict and interface, availability of weather barrier assembly materials and components, installer's training requirements, equipment, facilities and scaffolding, and coordinate methods, procedures and sequencing requirements for full and proper installation, integration and protection.

1.08 MOCK-UP

- A. Install weather barrier and accessories in a mock-up to be reviewed by the owner, architect, and contractor prior to the installation of the systems listed. Mock-up may not remain as part of the work.
- B. Contact manufacturer's designated representative prior to weather barrier assembly installation, to perform required mock-up visual inspection and analysis as required for warranty.
- C. General Contractor to coordinate integration of weather barrier system, exterior wall cladding and trim, furring, sheet metal flashing, window, sealant, and related accessories into the mock-up.

1.09 WARRANTY

A. Provide manufacturer's standard 10 year material warranty for air barrier membrane materials, sealant, and flashing membranes.

1.10 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

PART 2 PRODUCTS

2.01 WEATHER BARRIER ASSEMBLIES

- A. Water-Resistive Barrier: Provide on exterior walls under exterior cladding and where indicated in other sections.
- B. Air Barrier:
 - 1. On outside surface of sheathing of exterior walls use air barrier sheet, self-adhered type.
- C. Interior Vapor Retarder:
 - 1. On inside face of studs of exterior walls, under cladding, use mechanically fastened vapor retarder sheet.

2.02 AIR BARRIER MATERIALS (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)

- A. Air Barrier Sheet, Self-Adhered:
 - 1. Air Permeance: 0.004 cfm/sq ft, maximum, when tested in accordance with ASTM E2178.
 - 2. Water Vapor Permeance: 20 perms, minimum, when tested in accordance with ASTM E96/E96M Procedure A (desiccant procedure).
 - 3. Water Penetration Resistance Around Nails: Pass, when tested in accordance with ASTM D1970/D1970M (modified).

- Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up 4. to 90 days of weather exposure.
- Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed 5. index of 450 or less (Class A), when tested in accordance with ASTM E84.
- Water Resistance: Comply with applicable water-resistive requirements of ICC-ES AC38. 6.
- 7. Manufacturers:
 - a. Henry Company; Blueskin VP160: www.henry.com/#sle.
 - Grace Construction Products; Perm-A-Barrier:. b.
 - Substitutions: See Section 01 6000 Product Requirements. C.
- B. Air Barrier Coating Assembly: Combination of air barrier material and accessories assembled to provide a complete, integrated assembly, tested for air leakage in accordance with ASTM E2357; evaluated and approved by the Air Barrier Association of America.
 - Components: Includes Air Barrier Coating, Straight Flashing, Flexible Flashing, Sealants, 1. and other accessories required for complete air barrier system.
 - Assembly Air Permeance: 0.04 cubic feet per square foot, maximum, when tested in 2. accordance with ASTM E2357.
 - Performance: Provide an air barrier system constructed to perform as a continuous air 3. barrier and as a liquid water drainage plane flashed to discharge to the exterior any incidental condensation or water penetration. Membrane system shall accommodate movements of building materials providing expansion and control joints as required, with accessory air sealant materials at such locations, changes in substrate, perimeter conditions, and penetrations.

2.03 RAINSCREEN SUBGIRT COMPONENTS

- A. Zee Subgirts: Cold formed Z shaped steel.
 - Material: Fabricated from ASTM A653/A653M steel sheet, with G90/Z275 hot dipped 1. galvanized coating.
 - 2. Standards: Comply with Steel Stud Manufacturer Association (SSMA).
 - 3. Depth of web: As indicated on drawings.
 - Width of Leg: 3 inches, minimum. 4.
 - Gage: 12 gage 5.
 - 6. Shape: Z shape, pre-punched holes in web for moisture weeping.
- B. Hat Channels:
 - 1. Material: Fabricated from ASTM A653/A653M steel sheet, with G90/Z275 hot dipped galvanized coating.
 - 2. Standards: Comply with Steel Stud Manufacturer Association (SSMA).
 - Depth of web: As indicated on drawings. 3.
 - Gage: 16 gage. 4.
- C. Fasteners: Self-drilling. Comply with AISA Specifications for Screw Connections
 - 1. Size: #8 SMS
 - 2. Galvanized or Stainless Steel
 - Conform to SAE J78 3.

2.04 ACCESSORIES

- A. Sealants, Primers, Tapes, and Accessories for Sealing Weather Barrier and Sealing Weather Barrier to Adjacent Substrates: As specified or as recommended by weather barrier manufacturer. Type to be compatible with air barrier material and part of approved assembly.
- В. Neoprene Tape:
 - 1. Adhesive backed tape able to create thermal break between weather barrier system and Zee furring.
 - 2. Size: 1/8 inch thick by 3 inches wide.
 - Material: Neoprene foam tape compatible with weather barrier system. 3.
 - 4. Extent: Apply continuously over weather barrier system behind Zee furring.
 - Manufacturer: As recommended by manufacturer of weather barrier system. 5.

WEATHER BARRIERS

- C. Opening flashings, sill flashings, through-wall flashings, and transition membranes: Type compatible with air barrier material and part of manufacturer's approved assembly.
- D. Primers, Cleaners, and Sealants: As recommended by membrane manufacturer, appropriate to application, and compatible with adjacent materials.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and conditions are ready to accept the work of this section.

3.02 PREPARATION

A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

3.03 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Air Barriers: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
- C. Apply sealants and adhesives within recommended application temperature ranges. Consult manufacturer if temperature is out of this range.
- D. Coatings:
 - 1. Prepare substrate in manner recommended by coating manufacturer; treat joints in substrate and between dissimilar materials as recommended by manufacturer.
 - 2. Use flashing to seal to adjacent construction and to bridge joints.
- E. Openings and Penetrations in Exterior Weather Barriers:
 - 1. Install assembly components as indicated on drawings and according to the following.
 - 2. Install flashing over sills, covering entire sill frame member, extending at least 5 inches onto weather barrier and at least 6 inches up jambs; mechanically fasten stretched edges.
 - 3. At openings to be filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches wide; do not seal sill flange.
 - 4. At openings to be filled with non-flanged frames, seal weather barrier to each side of opening framing, using flashing at least 9 inches wide, covering entire depth of framing.
 - 5. At head of openings, install flashing under weather barrier extending at least 2 inches beyond face of jambs; seal weather barrier to flashing.
 - 6. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
 - 7. Service and Other Penetrations: Form flashing around penetrating item and seal to weather barrier surface.

3.04 INSTALLATION - RAIN SCREEN CAVITY

- A. Install furring strips as detailed, securing fasteners into wall framing. At windows, leave 1 inch gap at bottom of window to allow continuous air flow around window.
- B. Install vent material at top and bottom of each furred cavity, as indicated on drawings.
- C. Install insect screen continuously, securing to wall, folding over furring, and securing to furring with non-corrosive fasteners.
- D. Coordinate with installation of sheet metal flashing, weather barrier, and adjacent materials as detailed.

3.05 FIELD QUALITY CONTROL

- A. See Section 01 4000 Quality Requirements, for additional requirements.
- B. Do not cover installed weather barriers until required inspections have been completed.
- C. Take digital photographs of each portion of the installation prior to covering up.

3.06 PROTECTION

A. Do not leave materials exposed to weather longer than recommended by manufacturer.

SECTION 07 4113 METAL ROOF PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal roof panel system of preformed steel panels.

1.02 RELATED REQUIREMENTS

- A. Section 05 1200 Structural Steel Framing: Roof framing and purlins.
- B. Section 07 4213 Metal Wall Panels: Preformed wall panels.
- C. Section 07 9200 Joint Sealants: Sealing joints between metal roof panel system and adjacent construction.

1.03 REFERENCE STANDARDS

- A. AAMA 2605 Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2020, with Errata (2022).
- B. ASCE 7 Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- C. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- D. ASTM A792/A792M Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2010 (Reapproved 2015).
- E. ASTM A1011/A1011M Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.
- F. ASTM D1970/D1970M Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2019.
- G. ASTM E96/E96M Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- H. ASTM E1592 Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference; 2005 (Reapproved 2017).
- I. ASTM E1646 Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference; 1995 (Reapproved 2018).
- J. ASTM E1680 Standard Test Method for Rate of Air Leakage through Exterior Metal Roof Panel Systems; 2016 (Reapproved 2022).
- K. UL 580 Standard for Tests for Uplift Resistance of Roof Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Storage and handling requirements and recommendations.
 - 2. Installation methods.
 - 3. Specimen warranty.
- C. Shop Drawings: Include layouts of roof panels, details of edge and penetration conditions, spacing and type of connections, flashings, underlayments, and special conditions.
 - 1. Show work to be field-fabricated or field-assembled.
- D. Selection Samples: For each roofing system specified, submit color chips representing manufacturer's full range of available colors and patterns.

- E. Verification Samples: For each roofing system specified, submit samples of minimum size 12 inches square, representing actual roofing metal, thickness, profile, color, and texture.
- F. Test Reports: Indicate compliance of metal roofing system to specified requirements.
- G. Warranty: Submit specified manufacturer's warranty and ensure that forms have been completed in Owner's name and are registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section and with at least three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Provide strippable plastic protection on prefinished roofing panels for removal after installation.
- B. Store roofing panels on project site as recommended by manufacturer to minimize damage to panels prior to installation.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Architectural Metal Roof Panel Manufacturers:
 - 1. Basis of Design: AEP Span; Span-Lok Metal Roofing.
 - 2. Substitutions: See Section 01 6000 Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

- A. Metal Roof Panels: Provide complete roofing assemblies, including roof panels, clips, fasteners, connectors, and miscellaneous accessories, tested for compliance with the following minimum standards:
 - 1. Structural Design Criteria: Provide panel assemblies designed to safely support design loads at support spacing indicated, with deflection not to exceed L/180 of span length(L) when tested in accordance with ASTM E1592.
 - a. Live Loads: As required by ASCE 7.
 - 2. Overall: Complete weathertight system tested and approved in accordance with ASTM E1592.
 - 3. Wind Uplift: Class 90 wind uplift resistance of UL 580.
 - 4. Air Infiltration: Maximum 0.06 cfm/sq ft at air pressure differential of 6.24 lbf/sq ft, when tested according to ASTM E1680.
 - 5. Water Penetration: No water penetration when tested in accordance with procedures and recommended test pressures of ASTM E1646; perform test immediately following air infiltration test.
 - 6. Thermal Movement: Design system to accommodate without deformation anticipated thermal movement over ambient temperature range of 100 degrees F.

2.03 METAL ROOF PANELS

- A. Metal Roof Panels: Provide complete engineered system complying with specified requirements and capable of remaining weathertight while withstanding anticipated movement of substrate and thermally induced movement of roofing system.
- B. Metal Panels: Factory-formed panels with factory-applied finish.
 - 1. Steel Panels:
 - a. Aluminum-zinc alloy-coated steel complying with ASTM A792/A792M; minimum AZ50 coating.
 - b. Steel Thickness: Minimum 22 gauge, 0.028 inch.

- 2. Profile: Standing seam, with minimum 1-inch seam height; concealed fastener system for field seaming with special tool.
- 3. Texture: Smooth.
- 4. Length: Full length of roof slope, without lapped horizontal joints.
- 5. Width: Maximum panel coverage of 16 inches.

2.04 ATTACHMENT SYSTEM

A. Concealed System: Provide manufacturer's standard stainless steel or nylon-coated aluminum concealed anchor clips designed for specific roofing system and engineered to meet performance requirements, including anticipated thermal movement.

2.05 SECONDARY FRAMING

- A. Miscellaneous Secondary Framing: Light gauge steel framing incidental to structural supports; fabricated from steel sheet.
- B. Framing Material: ASTM A1011/A1011M, Designation SS steel sheet.
 - 1. Profile: Manufacturer's standard cee, zee, asymmetrical zee, hat channel, plain channel, single slope eave strut, double slope eave strut, and angle.
 - 2. Thickness: 12 gauge, 0.1046 inch.
 - 3. Finish: Galvanized per ASTM A653/A653M, G90.
- C. Framing Connectors: Factory-made formed steel sheet, ASTM A653/A653M SS Grade 50, with G60/Z180 hot dipped galvanized coating and factory punched holes.

2.06 FINISHES

A. Fluoropolymer Coil Coating System: Manufacturer's standard multi-coat metal coil coating system complying with AAMA 2605, including at least 70 percent polyvinylidene fluoride (PVDF) resin, and at least 80 percent of coil coated metal surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch; color and gloss to match sample.

2.07 ACCESSORIES

- A. Miscellaneous Sheet Metal Items: Provide flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, and equipment curbs of the same material, thickness, and finish as used for the roofing panels. Items completely concealed after installation may optionally be made of stainless steel.
- B. Rib and Ridge Closures: Provide prefabricated, close-fitting components of steel with corrosion resistant finish or combination steel and closed-cell foam.

C. Sealants:

- 1. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.
- 2. Concealed Sealant: Non-curing butyl sealant or tape sealant.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation of preformed metal roof panels until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Coordinate roofing work with provisions for roof drainage, flashing, trim, penetrations, and other adjoining work to ensure that completed roof will be free of leaks.
- B. Remove protective film from surface of roof panels immediately prior to installation; strip film carefully to avoid damage to prefinished surfaces.
- C. Separate dissimilar metals by applying a bituminous coating, self-adhering rubberized asphalt sheet, or other permanent method approved by metal roof panel manufacturer.

D. At locations where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.03 INSTALLATION

- A. Overall: Install roofing system in accordance with approved shop drawings and metal roof panel manufacturer's instructions and recommendations, as applicable to specific project conditions; securely anchor components of roofing system in place allowing for thermal and structural movement.
 - 1. Install roofing system with concealed clips and fasteners, except as otherwise recommended by manufacturer for specific circumstances.
 - 2. Minimize field cutting of panels. Where field cutting is required, use methods that will not distort panel profiles. Use of torches for field cutting is prohibited.
- B. Accessories: Install necessary components that are required for complete roofing assembly, including flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, equipment curbs, rib closures, ridge closures, and similar roof accessory items.
- C. Roof Panels: Install metal roof panels in accordance with manufacturer's installation instructions, minimizing transverse joints except at junction with penetrations.

3.04 CLEANING

A. Clean exposed sheet metal work at completion of installation. Remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving the work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to the finish.

3.05 PROTECTION

- A. Do not permit storage of materials or roof traffic on installed roof panels. Provide temporary walkways or planks as necessary to avoid damage to completed work. Protect roofing until completion of project.
- B. Touch-up, repair, or replace damaged roof panels or accessories before Date of Substantial Completion.

SECTION 07 4213 METAL WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured metal panels for exterior wall panels and subgirt framing assembly, with related flashings and accessory components.

1.02 RELATED REQUIREMENTS

- A. Section 06 1000 Rough Carpentry: Wall panel substrate.
- B. Section 07 2100 Thermal Insulation: Insulation behind wall panels.
- C. Section 07 2500 Weather Barriers: Rainscreen furring assembly.
- D. Section 07 6200 Sheet Metal Flahsing and Trim: Associated metal flashings.

1.03 REFERENCE STANDARDS

- A. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- B. ASTM A792/A792M Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2010 (Reapproved 2015).
- C. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- D. NFPA 285 Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components; 2019.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data Wall System: Manufacturer's data sheets on each product to be used, including:
 - 1. Physical characteristics of components shown on shop drawings.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation instructions and recommendations.
- C. Shop Drawings: Indicate dimensions, layout, joints, construction details, methods of anchorage, flashings, and terminations.
- D. Samples: Submit two samples of wall panel and soffit panel, 12 inches by 12 inches in size illustrating finish color, sheen, and texture.
- E. Manufacturer's Qualification Statement.
- F. Warranty Documentation for Installation of Building Rainscreen Assembly: Submit installer warranty and ensure that forms have been completed in Owner's name and registered with installer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

1.06 PRE-INSTALLATION MEETING

- A. Convene two weeks before starting work of this section.
- B. Review preparation and installation procedures, special conditions of the project.

1.07 MOCK-UP

- A. Construct mock-up, at least six feet long by six feet wide; include panel system, glazing, attachments to building frame, associated vapor retarder and air seal materials, weep drainage system, sealants and seals, related insulation in mock-up.
- B. Locate where directed by Architect.
- C. Mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.
- B. Store prefinished material off the ground and protected from weather; prevent twisting, bending, or abrasion; provide ventilation; slope metal sheets to ensure proper drainage.
- C. Prevent contact with materials that may cause discoloration or staining of products.

1.09 WARRANTY

- A. See Section 01 7800 Closeout Submittals, for additional warranty requirements.
- B. Provide 20 year manufacturer warranty for degradation of panel finish including chalking and fading, peeling, cracking, and delamination.
- C. Correct defective work within a five year period after Date of Substantial Completion, including defects in water tightness and integrity of seals for metal wall panels.
- D. Installation Warranty for Building Rainscreen Assembly: Installer of exterior rainscreen assembly (including air/vapor barrier and attachments, framing, and exterior panels) to provide 10-year warranty that includes coverage for defective materials and/or workmanship. This warranty will also clearly include materials, labor, necessary activity to access these areas, and removal of any materials to effect repairs and restore to watertight conditions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: AEP Span
- B. Substitutions: See Section 01 6000 Product Requirements.

2.02 MANUFACTURED METAL PANELS

- A. Wall Panel System: Factory fabricated prefinished metal panel system, site assembled.
 1. Provide exterior wall panels and subgirt framing assembly.
 - 1. Provide exterior wall panels and subgirt framing assembly.
 - 2. Design and size components to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of wall.
 - a. Design Pressure: In accordance with applicable codes.
 - b. Maximum Allowable Deflection of Panel: L/180 for length(L) of span.
 - c. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
 - 3. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
 - 4. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.
 - 5. Corners: Factory-fabricated in one continuous piece with minimum 18 inch returns.
 - 6. Provide continuity of air barrier and vapor retarder seal at building enclosure elements in accordance with materials specified in Section 07 2500.
- B. Exterior Wall Panels:
 - 1. Profile: Vertical and horizontal, as indicated; style as indicated.
 - 2. Side Seams: Double-interlocked, tight-fitting, sealed with continuous gaskets.

- 3. Material: Precoated steel sheet, minimum 22 gage thick minimum.
- 4. Panel Width: 12 inches.
- 5. Color: As indicated on drawings.
- 6. Attachment: Clip attached.
- 7. Profiles:
 - a. Metal Panel 1:
 - 1) Profile: Vertical, similar to AEP Span "Flex Series, 1.2Fx40x12".
 - 2) Color: As indicated on Drawings.
 - b. Metal Panel 2:
 - 1) Profile: Horizontal, similar to AEP Span "Prestige Series 12", no reveal.
 - 2) Color: As indicated on Drawings.
- C. Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered to required angles.
- D. Trim, Closure Pieces, Caps, Flashings, and Infills: Same material, thickness and finish as exterior sheets; brake formed to required profiles.
- E. Anchors: Galvanized steel.

2.03 MATERIALS

A. Precoated Steel Sheet: Aluminum-zinc alloy-coated steel sheet, ASTM A792/A792M, Commercial Steel (CS)) or Forming Steel (FS), with AZ50/AZM150 coating; continuous-coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.

2.04 FINISHES

- A. Exposed Surface Finish: Panel manufacturer's standard polyvinylidene fluoride (PVDF) coating, top coat over epoxy primer.
 - 1. 70 percent Kynar 500/Hylar 5000, consisting of a baked-on 0.15-0.20 mil corrosion resistant primer and a baked-on 0.70-0.80 mil finish coat with a specular gloss of 8 to 15 when tested in accordance with ASTM D523 at 60 degrees.
- B. Panel Backside Finish: Panel manufacturer's standard siliconized polyester wash coat.

2.05 ACCESSORIES

- A. Clips: As provided by manufacturer for specific panel system specified.
 - 1. Material: Formed steel, galvanized in conformance with ASTM A-653 Class G90.
 - 2. Panel clips designed to resist uplift forces and reduce permanent deflection of panel assembly under design loads.
- B. Trims and Flashings: Material, metal thickness, and finish to match panels. Profiles indicated in Drawings.
- C. Gaskets: Manufacturer's standard type suitable for use with system, permanently resilient; ultraviolet and ozone resistant.
- D. Concealed Sealants: Non-curing butyl sealant or tape sealant.
- E. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.
- F. Profile Closures: Polyethylene foam, die-cut or formed to panel configuration.
- G. Fasteners: Manufacturer's standard type to suit application; steel, hot dip galvanized.
- H. Field Touch-up Paint: As recommended by panel manufacturer.
- I. Bituminous Paint: Asphalt base.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that building framing members are ready to receive panels.

3.02 PREPARATION

- A. Install subgirts perpendicular to panel length, securely fastened to substrates and shimmed and leveled to uniform plane, and spaced at intervals indicated.
- B. Protect surrounding areas and adjacent surfaces from damage during execution of this work.

3.03 INSTALLATION

- A. Install panels, trims, closures, and flashings on walls in accordance with manufacturer's instructions.
- B. Comply with methods and recommendations of SMACNA Architectural Sheet Metal Manual for flashing configurations required.
- C. Protect surfaces in contact with cementitious materials and dissimilar metals with bituminous paint. Allow to dry prior to installation.
- D. Fasten panels to structural supports; aligned, level, and plumb.
- E. Secure panels without warp or deflection.
- F. Locate joints over supports.
- G. Cutting and Fitting:
 - 1. Cut panels neat, square, and true with shearing action cutters. Torch or power saw cutting is prohibited.
 - 2. Openings 6 inches and larger: Shop fabricate and reinforce to maintain original load capacity.
 - 3. Openings less than 6 inches: Field cutting is acceptable.
- H. Use concealed fasteners unless otherwise approved by Architect.
- I. Seal and place gaskets to prevent weather penetration. Maintain neat appearance.

3.04 TOLERANCES

- A. Maximum Offset From True Alignment Between Adjacent Members Butting or In Line: 1/16 inch.
- B. Maximum Variation from Plane or Location Indicated on Drawings: 1/4 inch.

3.05 CLEANING

- A. Remove site cuttings from finish surfaces.
- B. Remove protective material from wall panel surfaces.
- C. Panels or flashings with finish damage exposing metal or with substrate damage shall be replaced.
- D. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

SECTION 07 4623 WOOD SIDING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wood siding with boards for walls and soffits.

1.02 RELATED REQUIREMENTS

- A. Section 07 2500 Weather Barriers: Rainscreen furring assembly.
- B. Section 07 6200 Sheet Metal Flashing and Trim: Product requirements for metal flashings and trim associated with wood siding for placement by this section.
- C. Section 09 9000 Painting and Coating: Stain Finish

1.03 REFERENCE STANDARDS

- A. ASCE 7 Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. WCLIB (GR) Standard Grading Rules for West Coast Lumber No. 17; 2018.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's data on materials, component profiles, fastening methods, jointing details, sizes, surface texture, finishes, and accessories; showing compliance with requirements, including:
 - 1. Storage and handling requirements and recommendations.
 - 2. Installation instructions and recommendations.
- C. Samples: Submit two samples 6 by 6 inches in size to applicator of finish paint for use in preparation of finish samples.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store in ventilated areas with constant minimum temperature of 60 degrees F and maximum relative humidity of 55 percent.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Comply with local wind load resistance requirements of ASCE 7.

2.02 WOOD SIDING AND SOFFIT MATERIALS

- A. Grade lumber in accordance with the following:
 - 1. Western Red Cedar: WCLIB (GR).
 - 2. Grade: A-Clear, Kiln Dried.
- B. Board Siding: Flat, western red cedar, maximum moisture content of 10 percent.
 - 1. Vertical Wood Siding: 1x6 nominal, Tongue and Groove, V-Joint on one side (EV1S)
 - 2. Surface Texture: Sanded.

2.03 ACCESSORIES

- A. Nails: Corrosion resistant type; nonstaining, of size and strength to securely and rigidly retain the work; prefinished to match siding finish.
- B. Flashing: Galvanized steel; see Section 07 6200.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrates are ready to receive work.
- B. Verify that water-resistive barrier has been correctly and completely installed over substrate; see Section 07 2500.

- C. Do not begin until unacceptable conditions have been corrected.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 INSTALLATION

- A. Install siding, soffits, batten strips, and trim in accordance with manufacturer's instructions.
- B. Fasten siding and soffits securely in place, level and plumb.
 - 1. Arrange for orderly nailing pattern, blind nail except over trim.
 - 2. Install siding for natural shed of water.
 - 3. Position cut ends over bearing surfaces, and sand cut edges smooth and clean.
- C. Seal exposed wood substrates exposed to weather to prevent water accumulation and moisture intrusion.
 - 1. Seal penetrations.
 - 2. Seal exposed cuts of siding and trim; use of field-applied coatings is not permitted.
- D. Sand work smooth and set exposed nails and screws.
- E. Prepare for site finishing; see Section 09 9113.

3.03 TOLERANCES

- A. Maximum Variation from Plumb and Level: 1/4 inch per 10 feet.
- B. Maximum Offset from Joint Alignment: 1/16 inch.

SECTION 07 5400 THERMOPLASTIC MEMBRANE ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Mechanically Attached system with thermoplastic roofing membrane.
- B. Insulation, flat and tapered.
- C. Vapor retarder.
- D. Cover boards.
- E. Flashings.
- F. Roofing cant strips, stack boots, and walkway pads.

1.02 RELATED REQUIREMENTS

- A. Section 06 1000 Rough Carpentry: Wood nailers and curbs.
- B. Section 07 6200 Sheet Metal Flashing and Trim: Counterflashings.

1.03 REFERENCE STANDARDS

- A. ASTM C1177/C1177M Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
- B. ASTM C1289 Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2019.
- C. FM (AG) FM Approval Guide; current edition.
- D. FM DS 1-28 Wind Design; 2016.
- E. NRCA (RM) The NRCA Roofing Manual; 2019.
- F. NRCA (WM) The NRCA Waterproofing Manual; 2005.

1.04 PERFORMANCE REQUIREMENTS

- A. General: Install watertight, thermoplastic single-ply membrane roofing assembly as indicated with flashing system and compatible components that will not permit the passage of liquid water and will withstand wind loads, thermally induced movement, and exposure to weather without failure.
- B. Roofing System Design
 - 1. Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to 2019 Oregon Structural Specialty Code and ASCE/SEI 7-16. Wind loading is based on the following for Medford, Oregon.
 - a. Mean Roof Height: Approximately 30 feet
 - b. Roof Slope: 1/4":12 or less
 - c. Building Configuration: Enclosed
 - d. Exposure:
 - e. Risk Category:f. Basic Wind Speed:
 - 107 mph (OSSC 2019 Table 1609.3, category II)
 - 2. Provide roofing system that is identical to systems that have been successfully tested by qualified testing agency to resist unfactored service wind uplift pressure calculated according to the American Society of Civil Engineers (ASCE 7-16) with a factor of safety of 2.0.

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IV

C. Underwriters Laboratories (UL) Listed Products: Provide materials that have been tested and listed by UL, and bear UL label on each package, or are shipped to the project with a UL Certification of Compliance. A copy of said UL certificates shall be submitted to the Owner for each noted shipment received at the site.

D. Fire Performance Characteristics: Provide roofing system with materials and components that meet or exceed UL Class A requirements.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.
 - 1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.06 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements for submittal procedures.
- B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, vapor retarder, surfacing, and fasteners.
- C. Shop Drawings: Submit drawings that indicate joint or termination detail conditions, conditions of interface with other materials, setting plan for tapered insulation, and mechanical fastener layout.
- D. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article and herein.
 - 1. Written approval by membrane manufacturer for use and performance of membrane in this application, including that materials supplied for project comply with requirements of cited ASTM standards and Project Documents.
 - 2. Submit evidence of compliance with performance requirements including relevant assembly numbers.
 - 3. Certify that materials are free of asbestos.
 - 4. Manufacturer's Project Acceptance Document: Submit certification that manufacturer and installer will warrant roofing system for the specific site, design, details, and application indicated for this Project.
- E. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.
- F. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and supplementary instructions given.
- G. Manufacturer's qualification statement.
- H. Installer's qualification statement.
- I. Specimen Warranty: For approval.
- J. Warranty Documentation:
 - 1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
 - 2. Submit installer's certification that installation complies with warranty conditions for waterproof membrane.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with at least five years of documented experience.
- C. Source Quality Control:
 - 1. Manufacturer's Products: Obtain roofing materials from only one manufacturer. Provide materials that are not available from the manufacturer from sources that are recommended and approved by the manufacturer.
 - 2. Materials shall be obtained only from manufacturers who will, if required, send a qualified technical representative to the project site for the purpose of advising the Contractor on the procedures and precautions for use of the specified materials.

D. Supervision:

- 1. Installer shall maintain a full-time supervisor/foreman for each major area of work, who is on job site during times that roofing work is in progress, who is experienced in installing roofing systems similar to type and scope required for this Project, and is not performing actual installation work.
- E. Quality Standards:
 - 1. Cited Standards and specified manufacturers' catalogs, current at the date of bidding documents, unless otherwise specified, are incorporated herein by reference and govern the work. If conflict is discovered between referenced Standards or catalogs and the project specifications, request written clarification from the Owner and Architect/Engineer. Do not proceed with the work until receiving clarification.
 - 2. Comply with recommendations of the latest edition of the following standards:
 - a. SMACNA -"Architectural Sheet Metal Manual"
 - b. NRCA "The NRCA Roofing Manual"
 - c. Underwriters Laboratories (UL)
 - d. American Standard Testing and Materials (ASTM)
- F. Pre-installation Conference: Before installing roofing system, conduct conference at Project site to comply with requirements of Section 01 3000.
 - 1. Meet with Owner, Installer, manufacturer's technical representative, and installers whose work interfaces with or affects roofing including installers of roof accessories and other adjoining work, and representatives of other entities directly concerned with performance of roofing work.
 - 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 - 3. Review base flashings, special roofing details, roof drainage, roof penetrations, mechanical equipment curbs, and condition of other construction that will affect roofing system.
 - 4. Review requirements for inspections, testing, certifications, forecasted weather conditions, governing regulations, insurance requirements, and proposed installation procedures.
 - 5. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and attachment to structure.
 - 6. Review loading limitations of deck during and after roofing.
 - 7. Review governing regulations and requirements for insurance, certifications, and inspection and testing, if applicable.
 - 8. Review temporary protection requirements for roofing system during and after installation.
 - 9. Review roof observation and repair procedures after roofing installation.
 - 10. Review field constructed mock-ups.
 - 11. Record discussions of conference, including decisions and agreements (or disagreements) reached, and furnish copy of record to each party attending. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact.
- B. Store materials in weather protected environment, clear of ground and moisture.
- C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.
- D. Protect foam insulation from direct exposure to sunlight.

1.09 FIELD CONDITIONS

A. Do not apply roofing membrane during conditions outside of parameters recommended by roofing membrane manufacturer.
- B. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- C. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
- D. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.10 WARRANTY

- A. See Section 01 7800 Closeout Submittals for additional warranty requirements.
- B. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.
- C. Manufacturer's Roofing System Warranty:
 - 1. Written system warranty, non-prorated and without monetary limitation, signed by roofing system manufacturer, including:
 - a. Repair or replace components of roofing system that do not comply with requirements; that do not remain watertight; that fail in adhesion, cohesion, or general durability; or that deteriorate in manner not clearly specified by submitted roofing system manufacturer's data as inherent quality of material for application indicated.
 - b. Manufacturer's warranty includes roofing membrane, base flashings, roofing membrane accessories, and other components of the roofing system as supplied by the membrane manufacturer.
 - c. Failure includes roof leaks and defects that do not result in roof leaks such as blisters, partial seam voids, and wrinkles.
 - d. Labor and materials to perform warranty work.
 - 2. Warranty to include no failure for wind speed up to 55 mph.
 - 3. Warranty Period: Twenty years from date of completion of roofing system.
- D. Roofing Installer's Warranty
 - 1. Completed warranty form at end of Section, signed by Roofing Installer.
 - a. Repair or replace components of roofing system that do not comply with requirements; that do not remain watertight; that fail in adhesion, cohesion, or general durability; or that deteriorate in manner not clearly specified by submitted roofing system manufacturer's data as inherent quality of material for application indicated. Warranty includes defects such as blisters, partial seam voids, and wrinkles.
 - b. Removal and replacement of all other components of roofing system. Warranty includes replacing materials as necessary.
 - c. Labor and materials to perform warranty work.
 - 2. Warranty to include no failure for wind speed up to 55 mph.
 - 3. Warranty Period: Two years from date of completion of roofing.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Thermoplastic Polyvinyl Chloride (PVC) Membrane Roofing Materials:
 - 1. Carlisle Roofing Systems, Inc: www.carlisle-syntec.com/#sle
 - 2. GAF;: www.gaf.com/#sle.
 - 3. Johns Manville: www.jm.com/#sle.
 - 4. Sika Corporation Roofing; Sarnafil: usa.sarnafil.sika.com/#sle.
 - 5. Substitutions: See Section 01 6000 Product Requirements.

2.02 ROOFING - UNBALLASTED APPLICATIONS

A. Thermoplastic Membrane Roofing: One ply membrane, fully adhered, over vapor retarder and insulation.

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- B. Acceptable Insulation Types Constant Thickness Application: Any type that meets requirements and is approved by membrane manufacturer for application.
 1. Minimum 2 layers of polyisocyanurate board.
- C. Acceptable Insulation Types Tapered Application: Any type that meets requirements and is approved by membrane manufacturer for application.
 1. Tapered polyisocyanurate board.

2.03 MEMBRANE ROOFING AND ASSOCIATED MATERIALS

- A. Membrane Roofing Materials:
 - 1. Sheet Width: Factory fabricated into largest sheets possible.
 - 2. Color: white.
- B. Seaming Materials: As recommended by membrane manufacturer.
- C. Vapor Retarder / Air Barrier
 - 1. Self-adhered SBS modified bitumen vapor retarder/air barrier/temporary roofing membrane, 31 mils thick, with tri-laminated woven polyethylene facer that can accept approved urethane adhesives for insulation attachment.
 - a. Sika SA 31 (Basis of Design) with primer recommended by manufacturer.
 - b. Substitutions: See Section 01 6000 Product Requirements.
- D. Flexible Flashing Material: Same material as membrane.

2.04 COVER BOARDS

- A. Cover Boards: Glass-mat faced gypsum panels complying with ASTM C1177/C1177M and UL 1256.
 - 1. Thickness: 1/4 inch, fire-resistant.
 - 2. Products:
 - a. Georgia-Pacific; DensDeck Prime: www.densdeck.com/#sle.
 - b. Substitutions: See Section 01 6000 Product Requirements.

2.05 INSULATION

1.

- A. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.
 - Classifications:
 - a. Type II:
 - 1) Class 1 Faced with glass fiber reinforced cellulosic felt facers on both major surfaces of core foam.
 - 2) Compressive Strength: Classes 1-2-3, Grade 3 25 psi (172 kPa), minimum.
 - 3) Thermal Resistance: LTTR R-value of at least 5.56 per inch.
 - 2. Board Size: 48 by 48 inch.
 - 3. Board Thickness: 3.0 inch.
 - 4. Total thickness of continuous insulation: 6.0 inch
 - 5. Tapered Board: Slope as indicated; minimum thickness 1/4 inch; fabricate of fewest layers possible.
 - 6. Board Edges: Square.
 - 7. Products:
 - a. Dow Chemical Company: www.dowbuildingsolutions.com.
 - b. GAF;.: www.gaf.com.
 - c. Versico Roofing Systems: www.versico.com.
 - d. Firestone.
 - e. Johns Mansville
 - f. Substitutions: See Section 01 6000 Product Requirements.

2.06 ACCESSORIES

A. Primers: Primers for the membrane roofing shall be as recommended and supplied by the membrane manufacturer.

- B. Pre-Fabricated Penetration Flashings: Components pre-fabricated from same reinforced thermoplastic material as roofing membrane, or as recommended by membrane sheet manufacturer, including pipe flashing boots, corners, and T-joint covers.
- C. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.
- D. Insulation Joint Tape: Glass fiber reinforced type as recommended by insulation manufacturer, compatible with roofing materials; 6 inches wide; self adhering.
- E. Fasteners: Factory-coated steel fasteners and corrosion-resistant metal plates, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.
 1. General
 - a. Fasteners shall be as approved by manufactuer for substrates encountered including laboratory uplift resistance in accordance with Underwriters Laboratories (UL580). Tests for uplift resistance of roof assemblies.
 - b. Provide all mechanical fasteners and related items such as washers and plates, galvanized after fabrication and coated with two coats of corrosion-resistant coating.
 - c. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - d. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
 - 2. Non-corrosive metal, compatible with material being fastened or anchored. Spacing as noted on Drawings.
 - 3. Metal to Wood (Blocking): No. 4 Point, 12 24 by 2 inch, Phillips flat head stainless steel or with an approved corrosion resistant coating.
 - 4. Rivets: Solid rivets of same material as being connected.
 - 5. Expansion Inserts: Lead or nylon.
- F. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.1. Length as required for thickness of insulation material and penetration of deck substrate.
- G. Membrane Faced (Coated) Metal Flashings: Manufacturer's standard heat weld able membrane product fabricated of not less than 20 mils of same colored roofing membrane permanently bonded to commercial quality steel sheet, not less than 24 gauge, that has been hot-dipped galvanized according to ASTM A527, G90.
- H. Membrane Adhesive: As recommended by membrane manufacturer.
- I. Sealants: As recommended by membrane manufacturer.
- J. Walkway Pads: Suitable for maintenance traffic, contrasting color or otherwise visually distinctive from roof membrane.
 - 1. Composition: Roofing membrane manufacturer's standard.
 - 2. Size: As indicated.
 - 3. Surface Color: White or Gray.
 - 4. Location: As indicated on Drawings.
- K. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories including but not limited to:
 - 1. Sarnasolv (Basis of design)
 - 2. Sikaflex 1a (Basis of design)
 - 3. Sarnareglet (Basis of design)
 - 4. Multi-purpose tape (Basis of design)
 - 5. Aluminum tape (Basis of design)
 - 6. Elastomeric tape (Basis of design)
 - 7. Approved equal.
- L. Equipment: Hot Air Welding Equipment: Self-propelled machine suitable for type of hot air welding required and calibrated prior to beginning work of this project.

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- 1. Sanamatic (Basis of Design)
- 2. Approved equal

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and site conditions are ready to receive work.
- B. Verify deck is supported and secure.
- C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
- D. Verify deck surfaces are dry and free of snow or ice.
- E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.02 INSTALLATION, GENERAL

- A. Perform work in accordance with manufacturer's instructions, NRCA (RM), and NRCA (WM) applicable requirements.
- B. Do not apply roofing membrane during cold or wet weather conditions.
- C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.
- D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

3.03 INSTALLATION - VAPOR RETARDER AND INSULATION, UNDER MEMBRANE

- A. Install vapor retarder to deck surface with adhesive in accordance with manufacturer's instructions.
 - 1. Extend vapor retarder under cant strips and blocking to deck edge.
 - 2. Install flexible flashing from vapor retarder to air seal material of wall construction, lap and seal to provide continuity of the air barrier plane.
- B. Vapor Retarder:
 - 1. Install primer as required by membrane manufacturer.
 - 2. Install self-adhering sheet membrane wrinkle free. Apply primer if required by membrane manufacturer. Comply with temperature restrictions of membrane manufacturer for installation. Apply over entire roof, in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 4 inches. Roll laps with roller. Cover membrane within 28 days.
 - 3. All transitions, including but not limited to wood blocking and fall arrest stanchions, shall be treated with a 1 inch by 1 inch minimum fillet of sealant to ease transition of the membrane sheets. Seal transitions air tight.
 - 4. Vertical offsets that are 1/8 inch shall be pre-treated with an 8 inch wide strip of membrane centered over the joint. Vertical offsets greater than 1/8 inch shall be repaired to bring them into conformance with the project specifications.
 - 5. Sheet installation shall be done in such a way as to avoid stretching membrane while removing release paper. It is recommended that section of membrane be pre-cut to no more than 12 feet in length and allowed to fully relax prior to application.
 - 6. Patch misaligned or inadequately lapped seams with membrane. Slit any fishmouths, overlap the flaps, and repair with a patch of membrane and roll in place.
 - 7. At vent, fall arrest stanchions, and similar penetration locations, cut sheet around base of penetrations. Apply 1 inch sealant fillet at vertical transition. Install 24 inch square membrane target sheet centered on stanchion, tightly lapping up onto stanchion 3 inches minimum. Install stainless steel clamp ring and seal top edge with sealant for airtight flashing installation.

- 8. Flashing strips used to seal edges of transition or edge sections of membrane coated sheet metal shall be provided with 3 inch minimum laps onto primed sheet metal and membrane sheets unless otherwise noted on Drawings.
- 9. Turn membrane up wall surfaces and onto wood blocking as shown on Drawings. Seal top edge of overlap with sealant.
- C. Insulation:
 - 1. Only install as much insulation as can be covered in a day's roofing operation, and do not leave exposed to precipitation.
 - 2. Warped or bent insulation boards or boards with damaged facers shall not be used.
 - 3. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths.
 - 4. If installed in two layers, install with long joints in continuous straight lines with end joints staggered, with second layer transverse to first layer, with joints staggered at least one-third of overall length from those of first layer.
 - 5. Install in layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.
 - 6. Neatly cut and trim insulation to fit around penetrations and projections and fill voids with insulation.
 - 7. Comply with insulation manufacturer's written instructions applicable to products and applications included.
 - 8. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
 - 9. Use the largest appropriate section. Use of multiple smaller sections when a single larger section could be used will not be permitted.
 - 10. Mechanically fasten insulation to deck in accordance with roofing manufacturer's instructions and FM DS 1-28 Factory Mutual requirements.
- D. Cover Boards: Mechanically fasten cover boards in accordance with roofing manufacturer's instructions and FM (AG) Factory Mutual requirements.
- E. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.
- F. At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 24 inches.

3.04 COVER BOARD

- A. Cover Boards: Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset cover board joints a minimum of 6 inches in each direction and also from insulation board joints. Tightly butt boards together.
 - 1. Use longest appropriate boards. Use of multiple smaller boards when a single board will fit shall not be permitted.
 - 2. Cut and fit cover board within 1/4 inch of nailers, projections, and penetrations.
 - 3. At roof drains, trim surface of cover board where necessary so completed surface is flush and does not restrict flow of water.

3.05 INSTALLATION - MEMBRANE

- A. Adhere membrane roofing over area to receive roofing and install according to membrane roofing system manufacturer's written instructions.
- B. Clean cover board surfaces of debris, and ensure material is dry and smooth with no excessive surface imperfections that would telegraph through roofing membrane, and that there are no contaminated or unsound surfaces. Broken, delaminated, damaged, or wet boards shall be replaced with dry, sound material.
- C. Unroll membrane to complete length and position without stretching, allow to relax for amount of time recommended by manufacturer, inspect for damage, creases, or deficiencies, then reroll as recommended for installation.

- D. Apply primer to all horizontal and vertical cover board substrates to which the membrane is to be applied when the ambient temperature or substrate temperature is below 40 degrees F. Primer to be applied in strict accordance with the membrane manufacturer's application instructions. Do not apply primer during periods of inclement weather or when ambient temperatures are below 25 degrees F. Temperature must be a minimum of 25 degrees F for primer application.
- E. Bonding Adhesive: Apply to substrate and underside of membrane roofing at rate required by manufacturer and allow to partially dry before installing membrane roofing. Do not apply to splice area of membrane roofing.
- F. Carefully unroll membrane sheets into adhesive, overlapping edges as required by manufacturer for amount of material required for lapping. Keep sheets even and continue unrolling until sheet is laid flat. Wrinkles in material are not acceptable and should be removed and replaced. Remove and clean adhesive left exposed after sheet installation. Use large, weighted roller to embed sheet into adhesive.
- G. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- H. In addition to adhering, mechanically fasten membrane roofing securely at terminations, penetrations, and perimeter of roofing as required by membrane manufacturer for each roofing system.
- I. Apply membrane roofing with side laps shingled with slope of roof deck where possible.
- J. Seams: Clean seam areas, overlap membrane roofing, and hot-air weld side and end laps of membrane roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.
 - 1. Machine weld seams using the manufacturer's approved automatic welding equipment. When using this equipment, manufacturer's instructions shall be followed and local codes for electric supply, grounding, and over current protection observed. Dedicated circuit house power or a dedicated portable generator is recommended. No other equipment shall be operated simultaneously off the generator.
 - 2. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet membrane.
 - 3. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
 - 4. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.
- K. Install supplemental mechanical fastening system as required by the membrane manufacturer near roof perimeter and at transitions, peaks, valleys, and other locations according to manufacturer's requirements.

3.06 BASE FLASHING INSTALLATION

- A. Install sheet membrane, metal flashings, and preformed flashing accessories, and adhere to substrates according to membrane roofing system manufacturer's written instructions.
 - 1. Anchor units of work securely in place providing for thermal expansion of units; conceal fasteners where possible, and set units true to line and level.
 - 2. Install work to fit substrates with laps, joints, and seams that will be permanently watertight and weatherproof.
 - 3. Install exposed work without excessive oil canning, buckling, and tool marks, with exposed edges folded back to form hems.
 - 4. Provide for thermal expansion of exposed sheet metal work. Space movement joints at maximum of 10 feet with no joints within 24 inches of corners or intersections.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash inside and outside corners with prefabricated inside and outside membrane corner components.

- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Install termination bar and fasteners according to the detail drawings and manufacturer's requirements with approved fasteners into the structural deck at the base of parapets, walls, and curbs.
- F. All flashing membranes shall be consistently adhered to substrates. All interior and exterior corners and miters shall be cut and hot-air welded into place. No bitumen shall be in contact with the flashing membrane.
- G. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars at 8 inches on center maximum. Install elastomeric tape between termination bar and membrane.
- H. All membranes and membrane flashings that exceed 30 inches (0.75 m) in height shall receive additional securement.
- I. Test seams by probe. Install 6 by 6 inch minimum patch to repair open/damaged seam.
- J. Lapped Joints in Running Metal Flashings
 - 1. Lapping one piece over another of running flashings is not permitted.
 - 2. Joints in running metal flashings shall be formed with adjacent pieces butted together end-to-end with a 1/4 to 3/8 inch space between the ends. The joint shall then be covered with a splice plate with bed of bonding adhesive between the splice plate and the flashing pieces.

3.07 FIELD QUALITY CONTROL

- A. See Section 01 4000 Quality Requirements for additional requirements.
- B. Owner will provide testing services in accordance with Section 01 4000 Quality Requirements. Contractor to provide temporary construction and materials for testing.
- C. Owner's Representative will inspect roofing system at various stages of construction and at completion.
- D. If indicated by inspections, test cuts may be made to evaluate observed problems with roofing system.
 - 1. Approximate quantities of components within roofing membrane will be determined according to ASTM D3617.
 - 2. Test specimens will be examined for adhesive voids and seam voids.
- E. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit written report to the Owner and Architect/Engineer within five days of inspection. Notify Owner 48 hours in advance of date and time of inspection.
- F. Repair or remove and replace components of roofing system where test results or inspections indicate they do not comply with specified requirements.
- G. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- H. Testing responsibilities shall include the following:
 - 1. Seam Quality: Conduct testing of welded seams by obtaining 2 inch wide cross-section samples through completed seams, not less than three times a day, with first sample at beginning of the day's work, and evaluated immediately to verify that roofing membrane material will display failure from shearing prior to separation of seam. Note location of samples on submittals. If sample fails, examine seam further to determine reasons for failure. The samples must be dated and saved for evaluation by membrane manufacturer's Technical Representative. Each test cut shall be patched by the Applicator.

- 2. Seam Integrity: Conduct testing of all welded seams using a blunt-ended probing instrument, acceptable to membrane manufacturer, after seam has cooled for period of time recommended by membrane manufacturer.
- 3. Hot Air Welding Machine Calibration: Conduct daily testing of equipment and ensure air temperatures are within range recommended by manufacturer.
- 4. Agency shall submit written reports within five days of testing.
- I. Manufacturers Field Service
 - 1. Manufacturers shall provide qualified technical representative on-site intermittently or when required by Architect/Engineer during the roofing work.
 - 2. Representative shall inspect material and installation to ensure installation is proceeding in accordance with manufacturer's designs, recommendations and warranty requirements.
 - 3. Representative shall submit written reports within five days of inspection.
- J. Patching of sample cuts and retesting of materials failing to meet specified requirements shall be at Contractor's expense.

3.08 CLEANING

- A. See Section 01 7000 Execution and Closeout Requirements for additional requirements.
- B. See Section 01 7419 Construction Waste Management and Disposal for additional requirements.
- C. Remove bituminous markings from finished surfaces.
- D. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.
- E. Repair or replace defaced or damaged finishes caused by work of this section.

3.09 PROTECTION

- A. Protect installed roofing and flashings from construction operations.
- B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

SECTION 07 6200 SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fabricated sheet metal items, including flashings, counterflashings, gutters, downspouts, exterior penetrations, and other items indicated in Schedule.
- B. Sealants for joints within sheet metal fabrications.

1.02 RELATED REQUIREMENTS

- A. Section 04 2000 Unit Masonry: Metal flashings embedded in masonry.
- B. Section 04 2000 Unit Masonry: Through-wall flashings in masonry.
- C. Section 05 5000 Metal Fabrications: Cold-rolled steel gutters, scuppers, downspouts.
- D. Section 07 3113 Asphalt Shingles: Non-metallic flashings associated with shingle roofing.
- E. Section 07 4113 Metal Roof Panels: Flashings associated with roofing system.
- F. Section 07 4213 Metal Wall Panels: Flashings associated with wall panel system
- G. Section 07 5400 Thermoplastic Membrane Roofing: Flashings associated with roofing system.
- H. Section 07 9200 Joint Sealants: Sealing non-lap joints between sheet metal fabrications and adjacent construction.
- I. Section 07 9005 Joint Sealers.

1.03 REFERENCE STANDARDS

- A. AAMA 611 Voluntary Specification for Anodized Architectural Aluminum; 2020.
- B. AAMA 2605 Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2020, with Errata (2022).
- C. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- D. ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- E. ASTM B32 Standard Specification for Solder Metal; 2008 (Reapproved 2014).
- F. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- G. ASTM B209M Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- H. ASTM C920 Standard Specification for Elastomeric Joint Sealants; 2018.
- I. ASTM D226/D226M Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2017.
- J. ASTM D4586/D4586M Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2018).
- K. CDA A4050 Copper in Architecture Handbook; current edition.
- L. SMACNA (ASMM) Architectural Sheet Metal Manual; 2012.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.05 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

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C. Samples: Submit two samples 12 inch by 12 inch in size illustrating metal finish color.

1.06 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.
- B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with 5 years of documented successful experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

- A. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gauge, (0.0239 inch) thick base metal.
- B. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gauge, (0.0239) inch thick base metal, shop pre-coated with PVDF coating.
 - 1. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
 - 2. Color: As indicated on drawings.
- C. Aluminum: ASTM B209 (ASTM B209M); 20 gauge, 0.032 inch thick; anodized finish to match storefront finish.
 - Natural Anodized Finish: AAMA 611 AA-M12C22A42/44 Class I integrally or electrolytically colored anodic coating not less than 0.7 mils thick.
 a. Color: To match storefront.
- D. Stainless Steel: ASTM A666, Type 304 alloy, soft temper, minimum 28 gage, (0.0156 inch) thick; smooth No. 4 Brushed finish.

2.02 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Fabricate cleats of same material as sheet, minimum 2 inches wide, interlocking with sheet.
- C. Form pieces in longest possible lengths.
- D. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- E. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- F. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.
- G. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.
- H. Form material with standing seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
 - 1. Standing Seams: 1-inch high with sealant at folded corners.
 - 2. Solder-Lap Seams: 1-inch finish width; sweat full with solder.
 - 3. Double S Lock Seams: Form 1-1/4 inch with S shaped seam on each edge of flashing sheet for concealed fastening.
- I. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant. Solder galvanized steel that is not prefinished. Do not solder prefinished steel.
 - 1. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces

J. Roof-Edge Flashings: Secure metal flashings at roof edges according to Section 1505.5 of the Oregon Structural Specialty Code.

2.03 GUTTER AND DOWNSPOUT FABRICATION

- A. Gutters: Profile as indicated on Drawings
- B. Downspouts: Round profile.
- C. Gutters and Downspouts: Sizes as indicated on the drawings.
- D. Accessories: Profiled to suit gutters and downspouts.
 - 1. Anchorage Devices: In accordance with SMACNA (ASMM) requirements.
 - 2. Gutter Supports: Brackets.
 - 3. Downspout Supports: Brackets.
 - 4. Strainers
- E. Seal metal joints.

2.04 ACCESSORIES

- A. Fasteners: Galvanized steel, with soft neoprene washers.
- B. Underlayment: ASTM D226/D226M, organic roofing felt, Type I (No. 15).
- C. Slip Sheet: Rosin sized building paper.
- D. Primer: Zinc chromate type.
- E. Protective Backing Paint: Zinc molybdate alkyd.
- F. Concealed Sealants: Non-curing butyl sealant.
- G. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.
- H. Plastic Cement: ASTM D4586/D4586M, Type I.
- I. Solder: ASTM B32; Sn50 (50/50) type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.
- C. Verify that nailers and blocking are properly installed.

3.02 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

3.03 INSTALLATION

- A. Comply with drawing details.
- B. Install Work watertight, without waves, warps, buckles, tool marks, fastening stresses, distortion, or defects which impair strength of mar appearance.
- C. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..
- D. Apply plastic cement compound between metal flashings and felt flashings.
- E. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- F. Seal metal joints watertight.
- G. Install planes and lines in true alignment. Allow for sheet metal expansion and contraction.

- H. Gutters:
 - 1. Provide expansion joints midway between downspouts; provide end caps spaced 1/2 inch apart. Rivet and seal thimble flanges to gutter bottom.
 - 2. Cover expansion joint tops with loose-lock cover; extend cover over outer edge of gutter, and embed in sealant.
 - 3. Secure gutter to roof framing with straps spaced 24" o.c. max.
 - 4. Install gutters level.
- I. Downspouts:
 - 1. Attach to wall with 1 1/2" wide straps as scheduled. Reinforce straps to allow standoff from walls for straight drop.
 - 2. Locate straps at downspout tops, bottom, horizontal joints, and 10 ft maximum centers.
 - 3. Secure straps to wall with fastener heads covered with strap-tabs.
 - 4. Except where otherwise shown on Drawings, install downspouts plumb; modify straps if necessary.
 - 5. Connect downspouts to downspout boots installed by others. Grout connection watertight.
- J. Copings:
 - 1. Install copings with continuous cleat on the exterior side, fastened at 16 inches on center. Use exposed fasteners with neoprene washers through elongated holes on the roof side, at 24 inches on center.

3.04 SCHEDULE

- A. Gutters: Precoated steel, 24 gage.
- B. Downspouts: Precoated steel, 24 gage.
- C. Gutter and Downspout Supports and Straps: Match material, 14 gage.
- D. Drip Edge Flashings: 24 gage stainless steel.
- E. Drip Edge at Masonry Through-Wall Flashing: 24 gage stainless steel.
- F. Coping, Cap, Parapet, and Ledge Flashings: 24 gage precoated galvanized steel, unless otherwise indicated.
- G. Sill Flashings: 26 gage stainless steel.
- H. Roofing Penetration Flashings, for Pipes, Structural Steel, and Equipment Supports: 24 gage galvanized steel, unless otherwise indicated.
- I. Other flashings as shown on Drawings: As indicated.

SECTION 07 6500 FLEXIBLE FLASHING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flexible flashing at exterior openings
- B. Flexible flashing at exterior door and window openings.
- C. Flexible flashing above rigid board roof insulation at Eaves, Ridges, Valleys and Hips.

1.02 RELATED SECTIONS

- A. Section 04 2000 Unit Masonry.
- B. Section 07 2500 Weather Barriers
- C. Section 07 4113 Metal Roof Panels.
- D. Section 07 4213 Metal Wall Panels.
- E. Section 07 4623 Wood Siding
- F. Section 08 4313 Aluminum-Framed Storefronts

1.03 SUBMITTALS

- A. See Section 01300 Administrative Requirements, for submittal procedures.
- 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.
- C. Samples: Actual pieces of materials specified, not less than 3 by 5 inches.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site in manufacturer's original, sealed packaging.
- B. Stack flashing materials under cover, avoid twisting and deformation, and store products in manufacturer's unopened packaging until ready for installation.
- C. Store mastic materials in sealed containers that are protected from the weather.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Grace Construction Products" "Vycor V40 Weather Barrier Strips".
- B. Fortifiber Building Products Systems "Moistop E-Z Seal"
- C. Commercial Distributing, Inc., "Blueskin SA-40 Mil"
- D. Substitutions: See Section 01600 Product Requirements.

2.02 MATERIALS

- A. Flexible Flashing: Rubberized asphalt and cross-laminated polyethylene.
 - 1. Minimum Thickness of adhesive and backing: 40 mil.
 - 2. Width: 9 inches at door and window openings, as wide as practical above rigid board roof insulation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared and sloped so that water will drain to building exterior.
- B. Verify that surfaces to receive flashing are thoroughly dry, free from loose materials, and reasonably smooth, with no projections or sharp edges that could puncture flashing.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions and as indicated on Drawings.
 - 1. Extend head and sill flashings not less than 6 inches beyond openings and turn up to form watertight pan; seal with mastic.
- B. Flashing in Frame Construction: Coordinate with requirements of related sections. Install prior to installation or building paper, vapor barrier, and/or Slip Sheet.
- C. Seal flexible flashing tight to all penetrations.
- D. See Drawings for additional installation information.
 - 1. If the information on the Drawings conflicts with SMACNA recommendations, notify Architect.

3.03 SCHEDULE

- A. All exterior window and door perimeters. See drawings for typical installation.
- B. Provide at all exterior openings, including at all window, louver, and door penetrations. See drawings for typical installation and additional information, however, provide flashing whether or not work is described on the Drawings.
- C. Provide at all penetrations of exterior envelope building paper, including utility penetrations, such as, but not limited to conduit, ducts, piping, etc. Provide flashing whether or not work is described on the Drawings.

SECTION 07 7200 ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof hatches, manual and automatic operation, including smoke vents and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 05 5000 Metal Fabrications: Fixed steel ladders.
- B. Section 07 5400 Thermoplastic Membrane Roofing: Membrane roofing.
- C. Section 07 6200 Sheet Metal Flashing and Trim: Roof accessory items fabricated from sheet metal.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Maintenance requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products under cover and elevated above grade.

PART 2 PRODUCTS

2.01 ROOF HATCHES

- A. Roof Hatch Manufacturers:
 - 1. Acudor Products Inc; Galvanized Steel Roof Hatch: www.acudor.com/#sle.
 - 2. Babcock-Davis Hatchways, Inc.
 - 3. Bilco Company; Type TB (various types and special size): www.bilco.com/#sle.
 - 4. Dur-Red Products: www.dur-red.com/#sle.
 - 5. Milcor, Inc: www.milcorinc.com/#sle.
 - 6. Substitutions: See Section 01 6000 Product Requirements.
- B. Roof Hatches: Factory-assembled galvanized steel frame and cover, complete with operating and release hardware.
 - 1. Style: Provide flat metal covers unless otherwise indicated.
 - 2. Mounting: Provide frames and curbs suitable for mounting conditions as indicated on drawings.
 - 3. Size: As indicated on drawings; single-leaf style unless indicated as double-leaf.
- C. Frames and Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
 - 1. Material: Galvanized steel, 14 gauge, 0.0747 inch thick.
 - 2. Finish: Factory prime paint.
 - 3. Insulation: Manufacturer's standard; 1 inch rigid glass fiber, located on outside face of curb.
 - 4. Curb Height: 12 inches from finished surface of roof, minimum.
- D. Metal Covers: Flush, insulated, hollow metal construction.
 - 1. Capable of supporting 40 psf live load.
 - 2. Material: Galvanized steel; outer cover 14 gauge, 0.0747 inch thick, liner 22 gauge, 0.03 inch thick.

- 3. Finish: Factory prime paint.
- 4. Insulation: Manufacturer's standard 1 inch rigid glass fiber.
- 5. Gasket: Neoprene, continuous around cover perimeter.
- E. Hardware: Steel, zinc coated and chromate sealed, unless otherwise indicated or required by manufacturer.
 - 1. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf load.
 - 2. Hinges: Heavy duty pintle type.
 - 3. Hold open arm with vinyl-coated handle for manual release.
 - 4. Latch: Upon closing, engage latch automatically and reset manual release.
 - 5. Manual Release: Pull handle on interior.
 - 6. Locking: Padlock hasp on interior.
- F. Hatch Railing System:
 - 1. Provide a hatch rail system by hatch manufacturer, field assembled and installed per the manufacturer's instructions.
 - 2. Performance characteristics:
 - a. High visibility safety yellow color shall be molded in.
 - b. Hatch rail system shall attach to the capflashing of the roof hatch and shall not penetrate any roofing material.
 - c. Hatch rail system shall satisfy the requirements of OSHA 29 CFR 1910.23 and shall meet OSHA strength requirements with a factor of safety of two.
 - d. UV and corrosion resistant construction with a twenty-five year warranty.
 - e. Self-closing gate shall be provided with hatch rail system.
 - 3. Posts and Rails: Shall be round pultruded reinforced fire retardant yellow fiberglass treated with a UV inhibitor.
 - 4. Hardware: Mounting brackets shall be ¼" thick hot dip galvanized steel. Hinges and post guides shall be 6063T5 aluminum. Fasteners shall be Type 316 stainless steel.
- G. Safety Post:
 - 1. Steel, telescoping tubular section; automatic locking device; similar to Model 1 LadderUp" as manufactured by the Bilco Company.
 - 2. Stainless steel spring balancing mechanism for up and down movement.
 - 3. Black enamel finish.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.
- B. Adjust hinges for smooth operation.

3.04 CLEANING

- A. See Section 01 7000 Execution and Closeout Requirements for additional requirements.
- B. Clean installed work to like-new condition.

3.05 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

SECTION 07 7273 FALL ARREST ROOF ANCHORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Roof-mounted fall protection system including:
 - 1. Roof mounted fall arrest roof anchors.

1.02 RELATED SECTIONS

- A. Section 06 10 00 Rough Carpentry: Substrate for anchors.
- B. Section 07 5400 Thermoplastic Membrane Roofing: Substrate for anchors.
- C. Section 09 9000 Paint and Coating.

1.03 REFERENCES

- A. The work of this Section to conform to:
 - Occupational Safety & Health Administration (U.S. Department of Labor)
 - a. OSHA 1910.28, SubPart D (Walking-Working Surfaces)
 - b. OSHA 1910.66, SubPart F (Powered Platforms, Manlifts, and Vehicle-Mounted Work Platforms).
 - c. OSHA 1926.500, SubPart M (Fall Protection).
 - d. Department of Labor Memorandum to Regional Administrators for Descent Control Devices.
 - 2. American National Standards Institute
 - a. ANSI A39.1-1969 (Safety Requirements for Window Cleaning).
 - 3. American Society of Mechanical Engineers
 - a. ASME A120.1-1996 (Safety Requirements for Powered Platforms for Building Maintenance).
 - b. ASME Addenda A120.1a-1997 and A120.1b-1999.
 - 4. International Window Cleaner's Association
 - a. IWCA I 14 (Window Cleaning Safety Standard).
 - 5. American Society for Testing and Materials
 - a. ASTM D3963/D M-87 (Structural Specification for Epoxy Reinforcing Steel).
 - b. ASTM A36 (Non exposed Structural Components).
 - c. ASTM A123 (Standard Specification for Zinc Coating Hot Dip Galvanizing of Iron and Steel Products).
 - d. ASTM Z325 (Bolts, Nuts and Washers).
 - 6. American Welding Society
 - a. AWS D1.1 (Structural Welding Code)
 - 7. Aluminum Association
 - a. AA 5AS-30 (Specifications for Aluminum Structures)

1.04 SYSTEM DESCRIPTION

- A. Provide fall restraint and fall arrest system capable of withstanding loads and stresses within limits and under conditions specified in OSHA and other applicable safety codes. Provide fall protection anchors permanently attached to roof structure. Where indicated, provide cable lifeline system to allow continuous travel past intermediate anchors
- B. Design Requirements: Anchors and accessories comprising system of following types:
 - 1. Roof anchors, spaced as indicated, for safety snap connection by individual workers capable of withstanding a 5,000 pound load or safety factor of 2 meeting the requirements of OSHA 1926.502(d)(8).
 - 2. Continuous stainless steel cable lifeline restrained by swaged terminations at anchor points, suitable for multiple safety snap connections along cable between anchors.
 - 3. Tensioning system with tension indicator.

- 4. Pass-thru technology allowing workers cable shuttle to run freely pass intermediate anchors without the working having to disconnect / re-connect to the fall protection system.
- C. Performance Requirements: System and components tested for resistance of following loads:
 - 1. Fall Restraint: 4 persons simultaneously applied.
 - 2. Fall Arrest: 2 persons.
 - 3. Design fall protection anchors to resist at least 5,000 pound applied in any direction at a height of approximately 8 inches above top of roof deck or provide engineered system designed meeting the requirements of OSHA 1926.502(d)(8).
- D. Design safety anchor fall protection system to provide for roof access for maintenance of equipment and roof accessories.
- E. Co-ordinate work of this section, and location and magnitude of design loads, that would be imposed on the roof structure with the fabricators of these structural elements.
- F. Co-ordinate work of this Section with roofing systems to provide continuous waterproof protection.

1.05 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design fall arrest roof anchor system, including comprehensive engineering analysis by a qualified professional engineer licensed in the State of Oregon, using performance requirements and design criteria indicated.
- B. Delegated-Design Submittal: For fall arrest roof anchor system indicated to comply with performance requirements and design criteria, including product data and, where applicable, engineering judgment drawings signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Submit submittals as "Deferred Submittals" in accordance with Section 01 3000 Administrative Requirements. Transmit a copy of each submittal indicating agency approval to the Architect for record.

1.06 SUBMITTALS

- A. See Section 01 3300 Administrative Requirements, for submittal procedures.
- B. Manufacturer's descriptive literature for each product, including section or other type details.
- C. Manufacturer's written installation instructions.
- D. Shop drawings and samples in accordance with Section 01 30 00. Shop drawings to show roof layout indicating location and spacing of anchors, including dimensions, detail drawings of securement to structure, design details, and similar data. Drawings and calculations to bare stamp of Professional Engineer licensed in the State in which the project is located.
- E. Operation and Maintenance Data: Upon completion of project, provide written instructions for maintenance of fall prevention safety devices, and Log Book for mandatory annual inspection.
- F. Record Documents: Upon completion of project, provide Owner with roof plan showing layout of safety anchor system.

1.07 QUALITY ASSURANCE

- A. Fall arrest roof anchors manufacturer to have minimum 5 years documented experience in the design and fabrication of fall protection systems.
- B. Comply with all requirements of:
 - 1. OSHA Standards; Comply with Occupational Safety and Health Administration Standards for the Construction Industry 29 CFR 1296.500 Subpart M (Fall Protection), with applicable State Administrative Code safety standards for Fall Restraint and Fall Arrest.
 - 2. OSSC Oregon Structural Specialty Code Uniform Building Code

1.08 COORDINATION

A. Review documentation of structural deck, reinforcements, and anchorages to receive fall protection anchors.

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1.09 WARRANTY

A. Warrant products installed under this section of work to be free of leaks, condensation and defects in materials and/or manufacture for a period of 20 years when installed in accordance with the manufacturer's written instructions.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Basis of Design: Guardian Fall Protection, Model CB-18; 26609 79th Ave. S., Kent, WA 98032, Phone: 800-466-6385, ext. 113, Fax: 800-670-7892 www.guardianfall.com
- B. Super Anchor Safety, 8522-216th Street SE, Woodinville, WA 98072. Commercial Roof Anchor. Phone 425-488-8868 www.superanchor.com.
- C. Thaler Metal Industries, 1-800-387-7217, (Mississauga, Ontario, Canada) or 1-800-576-1200 (Niagara Falls, NY)
- D. Rooftop Anchor, Inc. 875 S 600 W, Heber City, Utah 84032 Phone (800) 411-3914, www.rooftopanchor.com
- E. 3M DBI/Sala Roofsafe 3833 SALA Way, Red Wing, MN 55066-5005, (800) 328-6146, www.3m.com/FallProtection
- F. Pro-Bel Enterprises Limited, ·765 Westney Road South, Ajax, Ontario, Canada. L1S 6W1, (800) 461-0575 U.S.A. Toll Free: www.pro-bel.ca
- G. Substitutions: See Section 01 6000 Product Requirements.

2.02 MANUFACTURED UNITS

- A. "Fixed Eye" Roof Anchors
 - 1. Materials:
 - a. Steel Plates, Bars: ASTM A240 / A240M 09a (Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications).
 - b. Wire Rope: ASTM A 492 Standard Specification for Stainless Steel Rope Wire.
 - c. Aluminum: ASTM B221 08 Standard Specifications for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 2. Finish: Hot Dipped Galvanized.
 - Extent: Roof Plan drawings indicate general area of Fall Arrest system coverage. Delegated Designer to prepare a system that covers the entire roof of the building.
 a. Single point anchors and Lifeline System at Single-Ply Membrane Roofing area.
 - 4. Verify size of base plates to suit conditions of use.
- B. Horizontal Life Line: K-703 "Easy Slider" Single Span Horizontal Life Line with two energy absorbers per span. Manufacturer's standard galvanized steel wire rope life line with manual release attachment devices and shock release system.
- C. Miscellaneous Fabricated Steel Attachments:
 - 1. Base Plates and Steel Reinforcement: Provide all accessory steel items required to attach to roof system.
 - 2. Steel Base Plate Fasteners: Type recommended by manufacturer for conditions of use.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine framing and substrate and verify conditions comply with structural requirements for proper system performance.
- B. Proceed with installation of roof anchors only after verifying conditions are satisfactory.
- C. Report to the Contractor in writing, defects of work prepared by other trades and other unsatisfactory site conditions. Verify site dimensions. Commencement of work will imply acceptance of prepared work.

3.02 PREPARATION

A. If necessary, protect building interior and contents against ingression of water, dust, debris or other material.

3.03 INSTALLATION

- A. Roof Anchors
 - 1. Install anchors or equipment in accordance with manufacturer's printed instructions, shop drawings, manufacturer's recommendations and as specified.
 - 2. Where necessary, provide protection against deterioration due to contact of dissimilar materials.
 - 3. Where bolting is used for fastening anchors, no fewer than two threads is to be exposed and the nut is to be positively locked by deforming threads, welding, pinning or equivalent method.
 - 4. Ensure work is inspected prior to application of roofing by the manufacturer's factory-trained representative.
- B. Steel Base Plate Attachment:
 - 1. Install steel base according to manufacturer's instructions.
- C. Flashing
 - 1. Install roof support flashing in accordance with anchor manufacturer's printed instructions, and coordinated with the roofing manufacturer and subcontractor.
 - 2. PVC Single Ply
 - a. Set deck flange in layer of membrane adhesive and extend single ply up sleeve to highest elevation possible and clamp membrane to flashing. Weld roofing to deck flange using PVC torch.

3.04 FIELD QUALITY CONTROL

A. Comply with the requirements of Section 01 40 00 - Quality Control.

3.05 ADJUSTING AND FINAL INSPECTION

- A. Verify that all manufactured units have been installed in accordance with specifications and details, and will function as intended. Adjust any items where necessary to ensure proper operation.
- B. Replace damaged or malfunctioning items.
- C. Provide necessary documentation certifying system is acceptable for service (Manufacturer's Certificate of Acceptance).

3.06 CLEANING

A. Clean manufactured units using materials and methods approved by manufacturer. Do not use cleaners or techniques which could impair performance of the roofing system.

3.07 DEMONSTRATION

A. Instruct Owner's designated safety engineer in proper use of fall prevention devices.

SECTION 07 8400 FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Firestopping systems.
- B. Firestopping of joints and penetrations in fire-resistance-rated and smoke-resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 RELATED REQUIREMENTS

- A. Section 01 6116 Volatile Organic Compound (VOC) Content Restrictions.
- B. Divisions 21, 22, 23, 26: Firestopping of mechanical, electrical, and plumbing work.

1.03 REFERENCE STANDARDS

- A. ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials; 2019.
- B. ASTM E814 Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- C. ASTM E2837 Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies; 2013 (Reapproved 2017).
- D. ASTM G21 Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.
- E. ITS (DIR) Directory of Listed Products; current edition.
- F. FM (AG) FM Approval Guide; current edition.
- G. SCAQMD 1168 Adhesive and Sealant Applications; 1989 (Amended 2017).
- H. UL 1479 Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.
- I. UL (FRD) Fire Resistance Directory; Current Edition.
- J. OSSC Oregon Structural Specialty Code: Current Edition

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements for submittal procedures.
- B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
- C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- D. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Certificate from authority having jurisdiction indicating approval of materials used.
- G. Manufacturer's qualification statement.
- H. Installer's qualification statement.

1.05 PERFORMANCE REQUIREMENTS

- A. Delegated-Design Submittal: For penetration firestopping indicated to comply with performance requirements and design criteria, including product data and, where applicable, engineering judgment drawings signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Submit submittals as "Deferred Submittals" in accordance with Section 01 30 00 Administrative Requirements. Transmit a copy of each submittal indicating agency approval to the Architect for record.

1.06 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
 - 1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
 - 2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
 - 3. For those firestop applications that exist but there is no UL tested system available through any manufacturer, a manufacturer's engineering judgement derived from similar UL system designs or other tests should be submitted by the contractor to local authorities having jurisdiction for their review and approval prior to installation.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section and:
 1. Verification of minimum three years documented experience installing work of this type.

1.07 SEQUENCING

A. Sequence Work to permit firestopping materials to be installed after adjacent and surrounding work is complete.

1.08 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Firestopping Materials: Any materials meeting requirements.
- B. Volatile Organic Compound (VOC) Content: Provide products having VOC content lower than that required by SCAQMD 1168.
- C. Mold and Mildew Resistance: Provide firestoppping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.
- D. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.
- E. Fire Ratings: See Drawings for required construction assemblies and ratings.

2.02 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. Head-of-Wall (HW) Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of wall assembly.
 - 1. Movement: Provide systems that have been tested to show movement capability as indicated.
- B. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
 - 1. For penetrations by combustible items including; insulated metal pipe, jacketed PVC, flexible cable or cable bundles, cable trays, and plastic pipe, an intumescent material is required to maintain fire rating of the assembly penetrated.

2.03 FIRESTOPPING SYSTEMS

- A. Firestopping: Any material meeting requirements.
 - 1. Fire Ratings: Use system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of

penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.

2. Surface Burning Characteristics: Conform to OSSC.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.

3.03 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authorities having jurisdiction.

3.04 IDENTIFICATION

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

3.05 CLEANING

A. Clean adjacent surfaces of firestopping materials.

SECTION 07 9005 JOINT SEALERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sealants and joint backing.

1.02 RELATED REQUIREMENTS

- A. Section 07 2500 Weather Barriers: Sealants required in conjunction with air barriers and vapor retarders:
- B. Section 07 8400 Firestopping: Firestopping sealants.
- C. Section 08 8000 Glazing: Glazing sealants and accessories.
- D. Section 09 2116 Gypsum Board Assemblies: Acoustic sealant.

1.03 REFERENCE STANDARDS

- A. ASTM C834 Standard Specification for Latex Sealants; 2017.
- B. ASTM C919 Standard Practice for Use of Sealants in Acoustical Applications; 2018.
- C. ASTM C920 Standard Specification for Elastomeric Joint Sealants; 2018.
- D. ASTM C1193 Standard Guide for Use of Joint Sealants; 2016.
- E. ASTM D2240 Standard Test Method for Rubber Property--Durometer Hardness; 2015, with Editorial Revision (2017).
- F. SCAQMD 1168 Adhesive and Sealant Applications; 1989 (Amended 2017).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with other sections referencing this section.

1.05 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, color availability, and installation instructions.
 - 1. Include temperature ranges for storage and application of materials, and special cold-weather application requirements or limitations.
 - 2. SpecData sheet for substrate cleaner and substrate primer recommended by sealant manufacturer for specific substrate surface and conditions.
- C. Samples: Submit two samples, 1/2 x 4 inch in size illustrating sealant colors for selection.
- D. Manufacturer's Installation Instructions: Indicate special procedures, surface preparation, and perimeter conditions requiring special attention.
- E. Certificate signed by sealant manufacturer, certifying that Installer complies with requirements.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years documented experience and approved by manufacturer.

1.07 MOCK-UP

- A. Provide mock-up of sealant joints in conjunction with window and wall under provisions of Section 01 4000.
- B. Construct mock-up with specified sealant types and with other components noted.
- C. Locate where directed.
- D. Mock-up may remain as part of the Work.

1.08 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.09 WARRANTY

- A. See Section 01 7800 Closeout Submittals, for additional warranty requirements.
- B. Correct defective workmanship within a two year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal and watertight seal, exhibit loss of adhesion or cohesion, or do not cure.
- D. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period for Silicone Sealants: 20 years from date of Substantial Completion.
 - 2. Warranty Period for All other Types of Sealants: 5 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Gunnable and Pourable Sealants:
 - 1. BASF Construction Chemicals-Building Systems: www.buildingsystems.basf.com.
 - 2. Bostik Inc: www.bostik-us.com.
 - 3. Dow Corning Corporation: www.dowcorning.com.
 - 4. Momentive Performance Materials, Inc (formerly GE Silicones): www.momentive.com.
 - 5. Pecora Corporation: www.pecora.com.
 - 6. Tremco Global Sealants: www.tremcosealants.com.
 - 7. Substitutions: See Section 01 6000 Product Requirements.

2.02 SEALANTS

- A. Sealants and Primers General: Provide only products having lower volatile organic compound (VOC) content than required by South Coast Air Quality Management District Rule No.1168.
- B. Definitions from ASTM C 920:
 - 1. Grade: Characteristics of sealant during installation. P Pourable, NS Non-Sag, SL, Self-Leveling,
 - 2. Class: Measurement of movement, as a percentage
 - 3. Uses: A appropriate for Aluminum, G appropriate for glass, I continuously submerged, M appropriate for Mortar, NT for non-traffic areas, T for traffic areas, O for use with other substrates not listed otherwise.
 - 4. Type: Type S Single Component, Type M Multi-Component
- C. General Purpose Exterior Sealant: Polyurethane; ASTM C920, Grade NS, Class 25 minimum; Uses M, G, and A; single component.
 - 1. Color: To be selected by Architect from manufacturer's standard range.
 - 2. Product: Similar to NP2 manufactured by Soneborn or equal.
 - 3. Applications: Use for:
 - a. Control, expansion, and soft joints in masonry.
 - b. Joints between concrete and other materials.
 - c. Joints between metal frames and other materials.
 - d. Other exterior joints for which no other sealant is indicated.
- D. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, Type OP, Grade NF single component, paintable.
 - 1. Color: To be selected by Architect from manufacturer's standard range.
 - 2. Product: Sonolac manufactured by Sonneborn or equal.

- 3. Applications: Use for:
 - a. Interior wall and ceiling control joints.
 - b. Joints between door and window frames and wall surfaces.
 - c. Other interior joints for which no other type of sealant is indicated.
- E. Bathtub/Tile Sealant: White silicone; ASTM C920, Uses I, M and A; single component, mildew resistant.
 - 1. Product: Omniplus manufactured by Sonneborn or equal.
 - 2. Applications: Use for:
 - a. Joints between plumbing fixtures and floor and wall surfaces.
 - b. Joints between kitchen and bath countertops and wall surfaces.
- F. Acoustical Sealant for Concealed Locations:
 - 1. Applications: Use for concealed locations only:
 - a. Sealant bead between top stud runner and structure and between bottom stud track and floor.
- G. Concrete Floor Joint Filler: Self-leveling, pourable, semi-rigid sealant intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
 - 1. Composition: Single or multi-part,100 percent solids by weight.
 - 2. Hardness: 85 after 7 days, when tested in accordance with ASTM D2240 Shore A.
 - 3. Color: Concrete gray.
 - 4. Joint Width: 1/8 inch.
 - 5. Joint Width, Maximum: 1/4 inch.
 - 6. Joint Depth: Provide product suitable for joints from 1/8 inch to 2 inches in depth including space for backer rod.
 - 7. Applications: Use for:
 - a. Control joints in concrete slabs and floors not filled with filler placed in form.
 - b. joints in concrete slabs and floors.
 - 8. Products:
 - a. Nox-Crete; DynaFlex 502: www.nox-crete.com
 - b. W.R. Meadows, Inc; Rezi-Weld Flex: www.wrmeadows.com.
 - c. Substitutions: See Section 01 6000 Product Requirements.
- H. Concrete Paving Joint Sealant: Polyurethane, self-leveling; ASTM C920, Class 25, Uses T, I, M and A; single component.
 - 1. Color: Gray.
 - 2. Applications: Use for:
 - a. Joints in sidewalks and vehicular paving.
 - 3. Products:
 - a. Bostik Inc: www.bostik-us.com.
 - b. Pecora Corporation: www.pecora.com.
 - c. BASF Construction Chemicals-Building Systems: www.buildingsystems.basf.com.
 - d. Substitutions: See Section 01 6000 Product Requirements.

2.03 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.
- E. Masonry Sand: Mason's Sand and Silica Mix for use over still wet sealant at all masonry control joints. Sand to closely match color and texture of mortar joints.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify that joint backing and release tapes are compatible with sealant.

3.02 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean and prime joints in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Protect elements surrounding the work of this section from damage or disfigurement.

3.03 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Perform acoustical sealant application work in accordance with ASTM C919.
- D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- E. Install bond breaker where joint backing is not used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- G. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- H. Tool joints concave. Remove and replace sealant in joints improperly tooled.
- I. Concrete Floor Joint Filler: Install concrete floor joint filler per manufacturer's written instructions. After floor joint filler is fully cured, shave joint filler flush with top of concrete slab.
- J. Spread Mason's Sand and Silica Mix over still wet sealant at all control joints in masonry walls.

3.04 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 - 1. Provide periodic field-adhesion testing as work progresses. Submit test results after each test.
 - 2. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
 - b. Perform 1 test for each 1000 feet of joint length thereafter or 1 test per each floor per elevation.
 - 3. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 - 4. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.

- 5. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
- 6. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.05 CLEANING

A. Clean adjacent soiled surfaces.

3.06 PROTECTION

A. Protect sealants until cured.

SECTION 08 1113 HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated hollow metal doors and frames.
- B. Rated and non-rated hollow metal frames for wood doors.
- C. Hollow metal borrowed lites glazing frames.
- D. Accessories, including glazing.

1.02 RELATED REQUIREMENTS

- A. Section 07 2100 Thermal Insulation.
- B. Section 08 1416 Flush Wood Doors.
- C. Section 08 7100 Door Hardware.
- D. Section 09 9000 Painting and Coating: Field painting of frames.

1.03 REFERENCE STANDARDS

- A. ADA Standards Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ANSI/SDI A250.4 Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.
- C. ANSI/SDI A250.8 Specifications for Standard Steel Doors and Frames (SDI-100); 2017.
- D. ANSI/SDI A250.10 Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
- E. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- F. ASTM A1008/A1008M Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2021a.
- G. ASTM A1011/A1011M Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.
- H. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- I. BHMA A156.115 American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2016.
- J. ICC A117.1 Accessible and Usable Buildings and Facilities; 2017.
- K. ITS (DIR) Directory of Listed Products; current edition.
- L. NAAMM HMMA 830 Hardware Selection for Hollow Metal Doors and Frames; 2002.
- M. NAAMM HMMA 831 Hardware Locations for Hollow Metal Doors and Frames; 2011.
- N. NAAMM HMMA 840 Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2007.
- O. NAAMM HMMA 861 Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.
- P. NFPA 80 Standard for Fire Doors and Other Opening Protectives; 2019.
- Q. NFPA 252 Standard Methods of Fire Tests of Door Assemblies; 2017.
- R. SDI 117 Manufacturing Tolerances for Standard Steel Doors and Frames; 2013.
- S. UL (DIR) Online Certifications Directory; Current Edition.

T. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. To provide a higher level of coordination the following building materials must be provided by the same sub-contractor.
 - 1. 08 1113 Hollow Metal Doors and Frames
 - 2. 08 1416 Flush Wood Doors
 - 3. 08 7100 Door Hardware
- B. The steel door and frame supplier shall be a manufacturer or distributor regularly engaged in supplying hollow metal products in this geographic area who has competent field personnel available to consult with the Architect and Contractor regarding applications or field installation problems.
- C. It is the intent of this specification to provide a general guideline for the quality, function, and design of the hollow metal doors, frames, and windows. It is the specific responsibility of the hollow steel supplier to furnish products which are fully functional, in full compliance with state and local building codes, fire codes, and disability and accessibility codes. Any supplier bidding on this section of the work shall notify the Architect prior to bidding, in accordance with Instructions to Bidders, of discrepancies or will be assumed to have included correct material to make this compliance.

1.05 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- 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, and any indicated finish requirements.
- D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
- E. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Hollow Metal Doors and Frames:
 - 1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com.
 - 2. Curries, an Assa Abloy Group company: www.assaabloydss.com.
 - 3. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
 - 4. Steelcraft, an Allegion brand: www.allegion.com/#sle.
 - 5. Substitutions: See Section 01 6000 Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

- A. Requirements for Hollow Metal Doors and Frames:
 - 1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM

A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.

- 2. Accessibility: Comply with ICC A117.1 and ADA Standards.
- 3. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- 4. Galvanizing : All components hot-dipped zinc-iron alloy-coated (galvannealed), minimum A40/ZF120.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

- A. Exterior Doors: Thermally insulated.
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 3 Extra Heavy-duty.
 - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 1 Full Flush.
 - d. Door Face Metal Thickness: 16 gage, 0.053 inch, minimum.
 - e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
 - 2. Door Core Material: Polyurethane, 1.8 lbs/cu ft minimum density.
 - a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.
 - 3. Door Thickness: 1-3/4 inches, nominal.
 - 4. Insulating Value: U-value of 0.35, when tested in accordance with ASTM C1363.
 - 5. Weatherstripping: Refer to Section 08 7100.
- B. Interior Doors, Non-Fire Rated:
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 1 Standard-duty.
 - b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 1 Full Flush.
 - d. Door Face Metal Thickness: 16 gage, 0.053 inch, minimum.
 - 2. Door Thickness: 1-3/4 inches, nominal.
- C. Fire-Rated Doors:
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 2 Heavy-duty.
 - b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 1 Full Flush.
 - d. Door Face Metal Thickness: 16 gage, 0.053 inch, minimum.
 - 2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
 - a. Provide units listed and labeled by UL (DIR) or ITS (DIR).
 - b. Attach fire rating label to each fire rated unit.
 - 3. Door Thickness: 1-3/4 inches, nominal.

2.04 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Interior Door Frames, Non-Fire Rated: Face welded type.

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- 1. Frame Metal Thickness: 18 gauge, 0.042 inch, minimum.
- C. Door Frames, Fire-Rated: Face welded type.
 - 1. Fire Rating: Same as door, labeled.

2.05 FINISHES

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

2.06 ACCESSORIES

- A. Glazing: As specified in Section 08 8000, factory installed.
- B. Exterior Frames: per Section 07 2119 Foamed-in-Place Insulation.
- C. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions for doors that do not have seals specified in 08 7110 Door Hardware schedule.
- D. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Fill frames in exterior walls with mineral wool insulatation. Fill frames in interior walls with mineral wool insulation or glass fiber batt insulation.
- E. Install door hardware as specified in Section 08 7100.
- F. Comply with glazing installation requirements of Section 08 8000.
- G. Coordinate installation of electrical connections to electrical hardware items.
- H. Touch up damaged factory finishes.

3.03 TOLERANCES

- A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.
- B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.04 ADJUSTING

A. Adjust for smooth and balanced door movement.

3.05 SCHEDULE

A. Refer to Door and Frame Schedule on the drawings.

SECTION 08 1416 FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flush wood doors; flush and flush glazed configuration; fire-rated and non-rated.
- B. Factory finishing.

1.02 RELATED REQUIREMENTS

- A. Section 08 1113 Hollow Metal Doors and Frames.
- B. Section 08 7100 Door Hardware.
- C. Section 08 8000 Glazing.

1.03 REFERENCE STANDARDS

- A. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- B. AWI/AWMAC/WI (AWS) Architectural Woodwork Standards; 2014, with Errata (2018).
- C. AWMAC/WI (NAAWS) North American Architectural Woodwork Standards, U.S. Version 3.1; 2017, with Errata (2019).
- D. UL 10C Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. To provide a higher level of coordination the following building materials must be provided by the same sub-contractor.
 - 1. 08 1113 Hollow Metal Doors and Frames
 - 2. 08 1416 Flush Wood Doors
 - 3. 08 7100 Door Hardware

1.05 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Samples: Submit two samples of door veneer, 12 by 12 inches in size illustrating wood grain, stain color, and sheen.
- D. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
- E. Warranty, executed in Owner's name.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.
 - 1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- B. Quality Certification:
 - Provide labels or certificates indicating that installed work will comply with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
 - 2. Provide designated labels on shop drawings as required by certification program.
 - 3. Provide designated labels on installed products as required by certification program.
 - 4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.07 MOCKUP

- A. Mockup one door with largest glass relite showing installation of door hardware, wood stops, glass and glazing tape.
- B. Approved mock up may remain as part of the work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging, and inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

1.09 WARRANTY

- A. See Section 01 7800 Closeout Submittals, for additional warranty requirements.
- B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
- C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Wood Veneer Faced Doors:
 - 1. Algoma: www.algomahardwoods.com.
 - 2. Lynden Door, Inc.
 - 3. Masonite Architectural; Aspiro Select Wood Veneer Doors: www.architectural.masonite.com/#sle.
 - 4. Vancouver Architectural Doors: www.vancouverdoorco.com.
 - 5. VT Industries: www.vtindustries.com.
 - 6. Western Oregon Door; www.oregondoor.com.
 - 7. Substitutions: See Section 01 6000 Product Requirements.

2.02 DOORS

- A. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain added urea formaldehyde or doors that comply with CA 01350, the State of California's Department of Health Services Standard Practice for testing chemical emissions from building products used in schools, offices and other sensitive environments. Third party certification for this testing is required.
- B. Doors: See drawings for locations and additional requirements.
 - 1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
 - 2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
- C. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
 - 1. Provide solid core doors at each location.
 - 2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C -Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.

2.03 DOOR AND PANEL CORES

- A. Doors with full light and half lite glass Non-Rated Solid Core: Type: Staved lumber core (SLC), plies and faces as indicated.
- B. All other doors Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.

C. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

2.04 DOOR FACINGS

- A. Veneer Facing for Transparent Finish: White Maple, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face; unless otherwise indicated.
 - 1. Vertical Edges: Compatible hardwood.
 - 2. "Pair Match" each pair of doors; "Set Match" pairs of doors within 10 feet of each other when doors are closed.
- B. Facing Adhesive: Type II water resistant.

2.05 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
 - 1. Provide solid blocks at lock edge for hardware reinforcement.
 - 2. Provide solid blocking for other throughbolted hardware.
- C. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- D. Fabricate any Fire Rated doors to receive panic hardware with inner blocking which will permit hardware installation without through-bolting
- E. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- F. Provide edge clearances in accordance with the quality standard specified.

2.06 FINISHES - WOOD VENEER DOORS

- A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 Finishing for grade specified and as follows:
 - 1. Transparent:
 - a. System 11, Polyurethane, Catalyzed.
 - b. Stain: As selected by Architect from manufacturer's standard colors.
 - c. Sheen: Satin.
- B. Factory finish doors in accordance with approved sample.

2.07 ACCESSORIES

A. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.
- E. Coordinate installation of glazing.
- F. At Wood Glazing Stops: Install stops flush on both faces of doors, with no door face veneer showing. Install with tight miter corners.
- G. Protect veneer from damage during construction. Do not wedge open doors with any material that might cause the veneer to split or chip.

3.03 TOLERANCES

- A. Comply with specified quality standard for fit and clearance tolerances.
- B. Comply with specified quality standard for telegraphing, warp, and squareness.
- C. Maximum Vertical Distortion (Bow): 1/8 inch measured with straight edge or taut string, top to bottom, over an imaginary 36 by 84 inches surface area.
- D. Maximum Width Distortion (Cup): 1/8 inch measured with straight edge or taut string, edge to edge, over an imaginary 36 by 84 inches surface area.

3.04 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

3.05 SCHEDULE

A. As shown on Drawings.

END OF SECTION

SECTION 08 3100 ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall mounted access units.
- B. Ceiling mounted access units.

1.02 RELATED REQUIREMENTS

A. Section 09 9000 - Painting and Coating: Field paint finish.

1.03 REFERENCE STANDARDS

- A. ITS (DIR) Directory of Listed Products; current edition.
- B. UL (FRD) Fire Resistance Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- C. Shop Drawings: Indicate exact position of each access door and/or panel unit.
- D. Manufacturer's Installation Instructions: Indicate installation requirements.
- E. Project Record Documents: Record actual locations of each access unit.

PART 2 PRODUCTS

2.01 WALL AND CEILING MOUNTED ACCESS UNITS

- A. Manufacturers:
 - 1. Activar Construction Products Group, Inc. JL Industries www.activarcpg.com/#sle.
 - 2. ACUDOR Products Inc: www.acudor.com/#sle.
 - 3. Barco Manufacturing.
 - 4. Cierra Products.
 - 5. Dur-Red Products; www.dur-red.com.
 - 6. Karp Associates, Inc: www.karpinc.com/#sle.
 - 7. Milcor, Inc: www.milcorinc.com/#sle.
 - 8. Substitutions: See Section 01 6000 Product Requirements.
- B. Wall and Ceiling Mounted Units: Factory fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
 - 1. Material: Steel.
 - 2. Style: Exposed frame with door surface flush with frame surface.
 - a. Gypsum Board Mounting Criteria: Use drywall bead type frame.
 - b. Plaster Mounting Criteria: Use plaster bead type frame.
 - 3. Door Style: Single thickness with rolled or turned in edges.
 - 4. Frames: 16 gauge, 0.0598 inch, minimum thickness.
 - 5. Single Steel Sheet Door Panels: 1/16 inch, minimum thickness.
 - 6. Units in Fire-Rated Assemblies: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
 - a. Provide products listed by ITS (DIR) or UL (FRD) as suitable for purpose indicated.
 - 7. Steel Finish: Primed.
 - 8. Primed and Factory Finish: Polyester powder coat; color as scheduled.
 - 9. Door/Panel Size: As indicated on the drawings.
 - 10. Hardware:
 - a. Hardware for Fire-Rated Units: As required for listing.
 - b. Hinges for Non-Fire-Rated Units: Continuous piano hinge.

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c. Latch/Lock: Screw driver slot for quarter turn cam latch.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings are correctly sized and located.

3.02 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings, and secure units rigidly in place.
- C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION

SECTION 08 4313 ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass.
- B. Aluminum doors and frames.
- C. Weatherstripping.

1.02 RELATED REQUIREMENTS

- A. Section 08 7100 Door Hardware: Hardware items other than specified in this section.
- B. Section 08 8000 Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

- A. AAMA CW-10 Care and Handling of Architectural Aluminum From Shop to Site; 2015.
- B. AAMA 611 Voluntary Specification for Anodized Architectural Aluminum; 2020.
- C. AAMA 1503 Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.
- D. ASCE 7 Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- E. ASTM A36/A36M Standard Specification for Carbon Structural Steel; 2019.
- F. ASTM B221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- G. ASTM B221M Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- H. ASTM E283/E283M Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
- I. ASTM E330/E330M Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
- J. ASTM E331 Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2009).

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, internal drainage details.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
- D. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.
- E. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
- F. Samples: Submit two samples 6 x 6 inches in size illustrating finished aluminum surface, glass, infill panels, glazing materials.
- G. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12" (300 mm) lengths of full-size components and showing details of the following:
 - 1. Joinery, including concealed welds.
 - 2. Anchorage.

- 3. Expansion provisions.
- 4. Glazing.
- 5. Flashing and drainage.
- H. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- I. Fenestration Certificate: To facilitate Energy Code compliance, provide a certificate specifying glazing type, special coatings, spacers, gas fills, center-of-glass and overall U-factor, and center-of-glass SHGC for every type of site built glass used. Maintain on the jobsite available for the building inspector.
- J. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
- K. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
- C. Mockups: Construct one window section to demonstrate complete installation assembly and set quality standard for materials and installation. Review with Owner and Architect before completing remaining work.
- D. Approved mock-up may remain as part of the work.
- E. Full-Size Mock-up Testing: Have a specimen representative of project conditions tested by an independent testing agency for compliance with specified air infiltration and water penetration criteria.

1.06 MOCK-UPS

- A. Mockups: Construct one window section to demonstrate complete installation assembly and set quality standard for materials and installation. Review with Owner and Architect before completing remaining work
- B. Locate as indicated on drawings.
- C. Mock-up may remain as part of work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY

- A. See Section 01 7800 Closeout Submittals, for additional warranty requirements.
- B. Provide two year warranty against defects in material and workmanship of curtainwall components.
- C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Kawneer North America: www.kawneer.com
- B. Other Acceptable Aluminum-Framed Storefronts Manufacturers:
 - 1. Oldcastle BuildingEnvelope: www.oldcastlebe.com/#sle.
 - 2. Substitutions: See Section 01 6000 Product Requirements.

2.02 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING

- A. Inside-Set Style, Thermally-Broken:
 - 1. Basis of Design: Basis of Design: Kawneer Series 451T.

2.03 ALUMINUM-FRAMED STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 - 1. Glazing Rabbet: For 1 inch insulating glazing.
 - 2. Glazing Position: Inside Set.
 - 3. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.
 - 4. Finish: Class I Dark Bronze Anodized.
 - a. Factory finish all surfaces that will be exposed in completed assemblies.
 - b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
 - 5. Finish Color: As scheduled.
 - 6. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 - 7. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 - 8. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
 - 9. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
 - 10. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
 - 11. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
 - 12. Preparation for Window Treatments: Provide reinforced interior horizontal head rail.
- B. Performance Requirements
 - 1. Wind Loads: Design and size components and system attachment methods to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
 - a. Design Wind Loads: Comply with requirements of ASCE 7, basic wind speed of 95 mph.
 - b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
 - 2. Water Penetration Resistance: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8.00 lbf/sq ft as defined in AAMA 501.
 - 3. Air Leakage: 0.06 cfm/sq ft maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf pressure difference.

4. Condensation Resistance Factor of Framing: 60, minimum, measured in accordance with AAMA 1503 with 1 inch insulating glass installed.

2.04 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
 - 1. Framing members for interior applications need not be thermally broken.
 - 2. Glazing Stops: Flush.
 - 3. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
- B. Glazing: As specified in Section 08 8000.
- C. Swing Doors: Glazed aluminum.
 - 1. Similar to Kawneer 500 Wide Stile Entrance.
 - 2. Thickness: 1-3/4 inches.
 - 3. Top Rail: 5 inches wide.
 - 4. Vertical Stiles: 5 inches wide.
 - 5. Bottom Rail: 10 inches wide.
 - 6. Glazing Stops: Square.
 - 7. Finish: Same as storefront.
- D. Infill Panels: Factory-formed, laminated, insulated aluminum panels for use as infill within stroefront and curtainwall systems.
 - 1. Thickness at edges: 1 inch, to fit standard 1 inch glazing pocket.
 - 2. Total thickness: Match interior face of storefront framing.
 - 3. Exterior finish: Class I Dark Bronze Anodized aluminum.
 - 4. Interior finish: Class I Dark Bronze Anodized aluminum.
 - 5. Core: Polystyrene, 2.0 lb density.
 - 6. Substrate: High-density polyethelene (HDPE).
 - 7. Manufacturer: Mapes Industried, or approved.
- E. Sills: Aluminum, manufacturer's standard for locations detailed.
- F. Deflection head channels: Aluminum, manufacturer's standard for locations detailed.

2.05 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M) 6063-T6 alloy and temper.
- B. Structural Steel Sections: ASTM A36/A36M; shop primed.
- C. Fasteners: Stainless steel.
- D. Exposed Flashings: Aluminum sheet, 20 gauge, 0.032 inch minimum thickness; finish to match framing members.
- E. Concealed Flashings: 0.018 inch thick galvanized steel.
- F. Glass: As specified in Section 08 8000.
- G. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- H. Glazing Accessories: As specified in Section 08 8000.

2.06 FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

2.07 HARDWARE

- A. For each door, include weatherstripping, sill sweep strip, and threshold.
- B. Door Hardware: As specified in Section 08 7100, except as included below.
- C. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.

- D. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all doors.
- E. Threshold: Extruded aluminum, one piece per door opening, ribbed surface; provide on all doors.
- F. Kick Plates: Synthetic sheet matching door finish. Kawneer Kydex Wear Shield or approved.
- G. Automatic Door Operators and Actuators: As specified in Section 08 7100.

2.08 FABRICATION

- A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- C. Prepare components to receive anchor devices. Fabricate anchors.
- D. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
- E. Arrange fasteners and attachments to conceal from view.
- F. Reinforce components internally for door hardware .
- G. Reinforce framing members for imposed loads.
- H. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.
 - 1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.02 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Coordinate attachment and seal of perimeter air and vapor barrier materials.
- I. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- J. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.
- K. Set thresholds in a bed of sealant and secure.
- L. Install glass and infill panels in accordance with Section 08 8000, using glazing method required to achieve performance criteria.
- M. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 FIELD QUALITY CONTROL

A. Test installed storefront for air infiltration in accordance with ASTM E783, with infiltration not to exceed 0.09 cfm/square foot.

3.05 ADJUSTING

A. Adjust operating hardware and sash for smooth operation.

3.06 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.
- C. Remove excess sealant by method acceptable to sealant manufacturer.

3.07 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 5800 ALUMINUM SLIDING SERVICE WINDOWS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sliding transaction windows at Reception..

1.02 RELATED REQUIREMENTS

- A. Section 01 3000 Administrative Requirements: Submittal procedures, project meetings, progress schedules and documentation, reports, coordination.
- B. Section 01 6000 Product Requirements: Fundamental product requirements, substitutions and product options, delivery, storage, and handling.
- C. Section 06 1000 Rough Carpentry: Supportive framing.
- D. Section 08 8000 Glazing.
- E. Section 09 2116 Gypsum Board Assemblies: Adjacent finishes.

1.03 REFERENCE STANDARDS

- A. AAMA 611 Voluntary Specification for Anodized Architectural Aluminum; American Architectural Manufacturers Association; 2012.
- B. AAMA CW-10 Care and Handling of Architectural Aluminum From Shop to Site; American Architectural Manufacturers Association; 2012.
- C. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2010.
- D. ASTM B221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2013.

1.04 SUBMITTALS

- A. Product Data: Provide Provide component dimensions, describe components within assembly, anchorage, fasteners and hardware..
- B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details. Include details, elevations and installation requirement of finish hardware and cleaning.
- C. Manufacturer's Qualification Statement.
- D. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Designer Qualifications: Perform design under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Deliver windows crated to provide protection during transit and job storage
- C. Inspect windows upon delivery for damage. Unless minor defects can be made to meet the Architect's specifications and satisfaction, damaged parts should be removed and replaced.
- D. Store windows at building site under cover in dry location.

1.07 FIELD CONDITIONS

A. Field measurements: Check opening by accurate field measurement before fabrication. Show recorded measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of work.

1.08 WARRANTY

A. Provide one year manufacturer warranty for all material and workmanship from the date of substantial completion.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

- A. Basis of Design: CR Laurence Co., Inc. website: www.crlaurence.com "Sharyn" Model.
- B. Other Acceptable Manufacturers:
 - 1. Ready Access website: www.ready-access.com
 - 2. Substitutions: See Section 01 6000 Product Requirements.
- C. Sliding Pass-Through Window:
 - 1. Frames: Frameless, except 2-1/2 inch extruded aluminum head rail concealing rollers.
 - 2. Hardware: Window glides on top-hung heavy-duty ball bearing slides. Locking mechanism.
 - 3. Operation: Two equal panels, one operating, one fixed, as shown on Drawings.
 - 4. Metal Finish: Clear, satin anodized.
 - 5. Glazing: Tempered, 1/4" thick minimum, per Section 08 8000.
 - 6. Locking Mechanism: Keyed cylinder mounted through hole in glass.
 - 7. Guides: Countertop mounted.
 - 8. Size: Custom, as shown on Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.03 TOLERANCES

- A. Maximum Variation From True Position: 1/18 inch.
- B. Maximum Offset From True Alignment: 1/16 inch.

3.04 CLEANING

A. Clean frame and glazing surfaces after installation, complying with requirements contained in the manufacturer's instructions. Remove excess glazing sealant compounds, dirt or other substances.

3.05 PROTECTION

A. Protect installed windows from subsequent construction operations.

SECTION 08 6223 TUBULAR SKYLIGHTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tubular skylights, consisting of skylight dome, reflective tube, and diffuser assembly.

1.02 RELATED REQUIREMENTS

A. Section 07 5400 - Thermoplastic Membrane Roofing

1.03 REFERENCE STANDARDS

- A. ASTM B209/B209M Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- B. ASTM D635 Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2018.
- C. ASTM E108 Standard Test Methods for Fire Tests of Roof Coverings; 2020a.
- D. UL 790 Standard for Standard Test Methods for Fire Tests of Roof Coverings; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- 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.
- C. Shop Drawings: Indicate configurations, dimensions, locations, fastening methods, and installation details.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.06 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.07 WARRANTY

- A. See Section 01 7800 Closeout Submittals, for additional warranty requirements.
- B. Skylights: Manufacturer's standard warranty for 10 years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Solatube International, Inc; SkyVault M74: www.solatube.com/#sle.
- B. Sunoptics Prismatic Skylights, a Division of Acuity Brands; LightFlex Tubular Daylighting System SLFT: www.sunoptics.com/#sle.
- C. Velux America, Inc; VELUX TCC Curb Mounted SUN TUNNEL Skylight: www.veluxusa.com/#sle.
- D. Substitutions: See Section 01 6000 Product Requirements.

2.02 TUBULAR SKYLIGHTS

- A. Tubular Skylights: Transparent roof-mounted skylight dome and curb, reflective tube, and ceiling level diffuser assembly, transferring sunlight to interior spaces.
 - 1. Fabrication and assembly of components is by single manufacturer.
 - 2. Non-Metal Parts: Flammability less than the following.
 - a. Roof-Top Components: Class B when tested in accordance with ASTM E108 or UL 790.
 - b. Combustibility Light Transmitting Parts: Minimum 2.5 inches/min (ICC Class CC-2), when tested in accordance with ASTM D635.
- B. Roof Assemblies: Transparent, UV and impact resistant dome with flashing base supporting dome and top of tube.
 - 1. Glazing: Acrylic plastic, 1/8 inch minimum thickness.
 - 2. Dome Ring: Attached to top of base section; 0.090 inch nominal thickness injection molded high impact ABS; to prevent thermal bridging between base flashing and tubing and channel condensed moisture out of tubing; weather seal of medium density pile weather stripping.
- C. Reflective Tube: ASTM B209/B209M aluminum sheet, thickness between 0.015 inch and 0.020 inch.
- D. Diffuser Assemblies: Supporting light transmitting surface at bottom termination of tube, with compression seal to minimize condensation and bug or dirt infiltration.
 - 1. Ceiling Ring: Edge trim for ceiling opening; injection molded high impact ABS.
 - 2. Diffuser Trim: Edge and attachment trim for diffuser lens; injection molded high impact ABS.
 - 3. Diffuser Shape at Solid Ceilings: Round, same diameter as tube.
 - 4. Diffuser Shape in Lay-In Ceiling Grid: Square, 24 by 24 inches, to fit grid; metal transition box.
 - 5. Lens: Flush frosted lens.
 - 6. Lens Material: Acrylic plastic.
 - 7. Visible Light Transmission (VLT): 90 percent, minimum.
 - 8. Seal: Closed cell EPDM foam rubber.

2.03 ACCESSORIES

- A. Fasteners: Same material as metals being fastened, non-magnetic steel, non-corrosive metal of type recommended by manufacturer, or injection molded nylon.
- B. Sealant: Elastomeric, silicone or polyurethane; compatible with materials being sealed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 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.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's written instructions.
- B. Set roof assembly flashing in continuous bead of sealant.
- C. Seal joints exposed to weather in accordance with sealant manufacturer's written instructions.

D. Conduct field test for water tightness; conduct water test in presence of Architect. Correct defective work and re-test until satisfactory.

3.04 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 08 7100 DOOR HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Hardware for wood, aluminum, and hollow metal doors.
- B. Hardware for fire-rated doors.
- C. Electrically operated and controlled hardware.
- D. Thresholds.
- E. Weatherstripping and gasketing.
- F. Exterior Gate locks and hardware.

1.02 RELATED REQUIREMENTS

- A. Section 07 9200 Joint Sealants: Sealants for setting exterior door thresholds.
- B. Section 08 1113 Hollow Metal Doors and Frames.
- C. Section 08 1416 Flush Wood Doors.
- D. Section 08 4313 Aluminum-Framed Storefronts: Door hardware, except as noted in section.
- E. Section 08 7110 Door Hardware Schedule
- F. Section 28 1000 Access Control: Electronic access control devices.
- G. Section 32 3119 Decorative Metal Fences and Gates.

1.03 REFERENCE STANDARDS

- A. ADA Standards Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. BHMA A156.1 American National Standard for Butts and Hinges; 2016.
- C. BHMA A156.2 American National Standard for Bored and Preassembled Locks & Latches; 2017.
- D. BHMA A156.3 American National Standard for Exit Devices; 2014.
- E. BHMA A156.4 American National Standard for Door Controls Closers; 2013.
- F. BHMA A156.5 American National Standard for Cylinders and Input Devices for Locks; 2014.
- G. BHMA A156.6 American National Standard for Architectural Door Trim; 2015.
- BHMA A156.8 American National Standard for Door Controls Overhead Stops and Holders; 2015.
- I. BHMA A156.13 American National Standard for Mortise Locks & Latches Series 1000; 2017.
- J. BHMA A156.16 American National Standard for Auxiliary Hardware; 2018.
- K. BHMA A156.18 American National Standard for Materials and Finishes; 2016.
- L. BHMA A156.21 American National Standard for Thresholds; 2014.
- M. BHMA A156.22 American National Standard for Door Gasketing and Edge Seal Systems Sponsor; 2017.
- N. BHMA A156.31 American National Standard for Electric Strikes and Frame Mounted Actuators; 2013.
- O. DHI (H&S) Sequence and Format for the Hardware Schedule; 1996.
- P. DHI (LOCS) Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames; 2004.
- Q. DHI WDHS.3 Recommended Locations for Architectural Hardware for Flush Wood Doors; 1993; also in WDHS-1/WDHS-5 Series, 1996.
- R. ICC A117.1 Accessible and Usable Buildings and Facilities; 2009

- S. NFPA 70 National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- T. NFPA 80 Standard for Fire Doors and Other Opening Protectives; 2019.
- U. NFPA 105 Standard for Smoke Door Assemblies and Other Opening Protectives; 2019.
- V. NFPA 252 Standard Methods of Fire Tests of Door Assemblies; 2017.
- W. OSSC Oregon Structural Specialty Code; latest edition
- X. UL (DIR) Online Certifications Directory; Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. This specification is intended as a guideline for quality and operation and is not to be construed as a complete list. It is the specific responsibility of the hardware supplier to furnish complete hardware for all openings that is functional, meets the Owner's intended use, and in full compliance with all State and Local Building Codes, Fire Codes, disability and accessibility codes. Any supplier bidding on this section of the work shall notify the Architect prior to bidding, in accordance with Division 0 requirements of discrepancies or will be assumed to have included correct material to make this compliance
- B. To provide a higher level of coordination the following building materials must be provided by the same sub-contractor.
 - 1. 08 1113 Hollow Metal Doors and Frames
 - 2. 08 1416 Flush Wood Doors
 - 3. 08 7100 Door Hardware
- C. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.
- D. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.
- E. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.
- F. Keying Requirements Meeting:
 - Attendance Required:
 - a. Contractor.
 - b. Owner.
 - c. Architect.
 - d. Installer's Architectural Hardware Consultant (AHC).
 - 2. Agenda:

1.

- a. Establish keying requirements.
- b. Verify locksets and locking hardware are functionally correct for project requirements.
- c. Verify that keying and programming complies with project requirements.
- d. Establish keying submittal schedule and update requirements.
- 3. Incorporate "Keying Requirements Meeting" decisions into keying submittal upon review of door hardware keying system including, but not limited to, the following:
 - a. Access control requirements.
 - b. Key control system requirements.
- 4. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.
- 5. Deliver established keying requirements to manufacturers.

1.05 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.

- C. Shop Drawings Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.
 - 1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).
 - 2. Comply with DHI (H&S) using door numbers and hardware set numbers as indicated in construction documents.
 - a. Submit in vertical format, refer to Section 08 0671.
 - 3. List groups and suffixes in proper sequence.
 - 4. Door numbers must be in numerical sequence.
 - 5. Provide complete description for each door listed.
 - 6. Provide manufacturer's and product names, and catalog numbers; include functions, types, styles, sizes and finishes of each item.
 - a. Include clean and clear digital catalog cut sheets with products to be used on the project properly highlighted.
 - 7. Include account of abbreviations and symbols used in schedule.
- D. Shop Drawings Electrified Door Hardware: Submit diagrams for power, signal, and control wiring for electrified door hardware that include details of interface with building safety and security systems. Provide elevations and diagrams for each electrified door opening as follows:
 - 1. Prepared by or under supervision of Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC).
 - 2. Elevations: Submit front and back elevations of each door opening showing electrified devices with connections installed and an operations narrative describing how opening operates from either side at any given time.
 - 3. Diagrams: Submit point-to-point wiring diagram that shows each device in door opening system with related colored wire connections to each device.
- E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- F. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
- G. Keying Schedule:
 - 1. Submit one digital copies of Keying Schedule in compliance with requirements established during Keying Requirements Meeting unless otherwise indicated.
- H. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- I. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.
- J. Operations & Maintenance Data: Hardware supplier will reissue a complete schedule when changes occur during the project, and will supply the contractor with a digital copy of the final hardware schedule for the O & M Manual.
- K. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 Product Requirements, for additional provisions.
 - 2. Lock Cylinders: Ten for each master keyed group.
 - 3. Tools: One set of each special wrench or tool applicable for each different or special hardware component, whether supplied by hardware component manufacturer or not.

1.06 QUALITY ASSURANCE

- A. Standards for Fire-Rated Doors: Maintain one copy of each referenced standard on site, for use by Architect and Contractor.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

- C. Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least three years of documented experience.
- D. Hardware Supplier Qualifications: Company specializing in supplying the type of products specified in this section with at least three years documented experience, and with certified Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC) to assist in work of this section.
- E. Prior to final project acceptance, supplier's representative shall make one field inspection and certify, in writing to the Architect, that hardware installation complies with the project documents, approved hardware schedule, and Manufacturer's instructions, and that installation is complete and all hardware items have been properly installed and correctly adjusted, or provide a list of items that require correction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

1.08 WARRANTY

- A. See Section 01 7800 Closeout Submittals, for additional warranty requirements.
- B. Provide Manufacturer's Standard Warranty against defects in material and workmanship for period indicated, from Date of Substantial Completion.
 - 1. Closers: Five years, minimum.
 - 2. Exit Devices: Three years, minimum.
 - 3. Locksets and Cylinders: Three years, minimum.
 - 4. Other Hardware: Two years, minimum.

PART 2 PRODUCTS

2.01 RESPONSIBILITY

A. This specification is intended as a guideline for quality and operation and is not to be construed as a complete list. It is the specific responsibility of the hardware supplier to furnish complete hardware for all openings that is functional, meets the Owner's intended use, and in full compliance with all State and Local Building Codes, Fire Codes, disability and accessibility codes. Any supplier bidding on this section of the work shall notify the Architect prior to bidding, of any observed discrepancies or will be assumed to have included correct material to make this compliance.

2.02 DESIGN AND PERFORMANCE CRITERIA

- A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.
- B. Provide individual items of single type, of same model, and by same manufacturer.
- C. Provide door hardware products that comply with the following requirements:
 - 1. Applicable provisions of federal, state, and local codes.
 - 2. Accessibility: ADA Standards and ICC A117.1.
 - 3. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified.
- D. Electrically Operated and/or Controlled Hardware: Provide necessary power supplies, power transfer hinges, relays, and interfaces as required for proper operation; provide wiring between hardware and control components and to building power connection in compliance with NFPA 70.
 - 1. Coordinate the installation, wiring and operation of any automatic door operators and electric strikes with any access control system.
- E. Lock Function: Provide lock and latch function numbers and descriptions of manufacturer's series. Refer to Door Hardware Schedule.

- F. Surface Mounted Closers: Check degree of opening for all closers. Mount closer away from exterior, halls, corridors and public spaces. Notify Architect during the Submittal Review process if specified closers do not comply with this requirement. Unless specifically specified, do not restrict door swing.
- G. Fasteners:
 - 1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.
 - a. Aluminum fasteners are not permitted.
 - b. Provide phillips flat-head screws with heads finished to match door surface hardware unless otherwise indicated.
 - Provide machine screws for attachment to reinforced hollow metal and aluminum frames.
 a. Self-drilling (Tek) type screws are not permitted.
 - 3. Provide wall grip inserts for hollow wall construction.
 - 4. Provide spacers or sex bolts with sleeves for through bolting of hollow metal doors and frames.
 - 5. Fire-Rated Applications: Comply with NFPA 80.
 - a. Provide wood or machine screws for hinges mortised to doors or frames, strike plates to frames, and closers to doors and frames.
 - b. Provide steel through bolts for attachment of surface mounted closers, hinges, or exit devices to door panels unless proper door blocking is provided.

2.03 HINGES

- A. Hinges: Provide hinges on every swinging door unless otherwise indicated.
 - 1. Provide five-knuckle full mortise ball-bearing butt hinges unless otherwise indicated.
 - 2. Provide hinges in the quantities indicated.
 - 3. Provide non-removable pins on all outswinging exterior and interior doors.
 - 4. Where electrified hardware is mounted in door leaf, provide power transfer hinges unless otherwise indicated.
- B. Manufacturers:
 - 1. McKinney; an Assa Abloy Group company: www.assaabloydss.com.
 - 2. Bommer Industries, Inc: www.bommer.com/#sle.
 - 3. Hager Companies: www.hagerco.com/#sle.
 - 4. Stanley, dormakaba Group: www.stanleyhardwarefordoors.com/#sle.
 - 5. Substitutions: See Section 01 6000 Product Requirements.
- C. Hinges: Comply with BHMA A156.1, Grade 1.
 - 1. Provide hinges on every swinging door.
 - 2. Provide ball-bearing hinges at each door with closer.
 - 3. Provide following quantity of butt hinges for each door:
 - a. Doors From 60 inches High up to 90 inches High: Three hinges.
 - b. Doors 90 inches High up to 120 inches High: Four hinges.

2.04 FLUSH BOLTS

- A. Flushbolts: Lever extension bolts in leading edge of door, one bolt into floor, one bolt into top of frame.
 - 1. Pairs of Swing Doors: At inactive leaves, provide flush bolts of type as required to comply with code.
 - 2. Floor Bolts: Provide dustproof strike except at metal thresholds.
- B. Manual Flushbolts: Provide lever extensions for top bolt at over-size doors.
- C. Automatic Flushbolts: Automatically latch upon closing of door; automatic retraction of bolts when active leaf is opened.
- D. Coordinators: Provide on doors having closers and self-latching or automatic flushbolts to ensure that leaves close in proper order.

- E. Manufacturers:
 - 1. Rockwood, an Assa Abloy Group company: www.assaabloydss.com/#sle.
 - 2. Substitutions: See Section 01 6000 Product Requirements.
- F. Flush Bolts: Comply with BHMA A156.16, Grade 1.
 - 1. Flush Bolt Throw: 3/4 inch, minimum.

2.05 EXIT DEVICES

- A. Manufacturers:
 - 1. Von Duprin, an Allegion brand: www.allegion.com/us.
 - 2. Substitutions: See Section 01 6000 Product Requirements.
- B. Exit Devices: Comply with BHMA A156.3, Grade 1.
 - 1. Lever design to match lockset trim.
 - 2. Provide cylinder with cylinder dogging or locking trim, unless notes otherwise.
 - 3. Provide exit devices properly sized for door width and height.
 - 4. Provide strike as recommended by manufacturer for application indicated.
 - 5. For electrical options, provide quick connect plug-in pre-wired connectors.

2.06 ELECTRIC STRIKES

- A. Manufacturers:
 - 1. Von Duprin, an Allegion brand: www.allegion.com/us.
 - 2. Substitutions: See Section 01 6000 Product Requirements.
- B. Electric Strikes: Comply with BHMA A156.31, Grade 1.
 - 1. Provide UL (DIR) listed burglary-resistant electric strike; style to suit locks.
 - 2. Provide non-handed 24 VDC electric strike suitable for door frame material and scheduled lock configuration.
 - 3. Provide transformer and rectifier as necessary for complete installation.
 - 4. Connect electric strikes into fire alarm where non-rated doors are scheduled to release with fire or sprinkler alarm condition.

2.07 LOCK CYLINDERS

- A. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.
 - 1. Provide conventional type cylinders, Grade 1, with six-pin core in compliance with BHMA A156.5 at locations indicated.
 - 2. Keyway: SARGENT HB
 - 3. Provide cylinders from same manufacturer as locking device.
 - 4. Provide cams and/or tailpieces as required for locking devices.
 - 5. Within specific Door Sections, when provisions for lock cylinder are being referenced to this Section, provide specified lock cylinder and keyed to building keying system, unless otherwise indicated.

2.08 CYLINDRICAL LOCKS

- A. Manufacturers:
 - 1. Sargent; an Assa Abloy Group company: www.assaabloydss.com.
- B. Cylindrical Locks (Bored): Comply with BHMA A156.2, Grade 1, 4000 Series.
 - 1. Bored Hole: 2-1/8 inch diameter.
 - 2. Latchbolt Throw: 1/2 inch, minimum.
 - 3. Backset: 2-3/4 inch unless otherwise indicated.
 - Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
 a. Finish: To match lock or latch.
 - 5. Provide a lock for each door, unless otherwise indicated that lock is not required.
 - 6. Provide an office lockset for swinging door where hardware set is not indicated.
 - 7. Trim: Provide lever handle or pull trim on outside of each lock, unless otherwise indicated.

2.09 MORTISE LOCKS

- A. Manufacturers:
 - 1. Sargent; an Assa Abloy Group company: www.assaabloydss.com.
- B. Mortise Locks: Comply with BHMA A156.13, Grade 1, Security, 1000 Series.
 - 1. Latchbolt Throw: 3/4 inch, minimum.
 - 2. Deadbolt Throw: 1 inch, minimum.
 - 3. Backset: 2-3/4 inch unless otherwise indicated.
 - 4.
- a. Finish: To match lock or latch.

2.10 PUSH/PULL LOCKS / LATCHES

- A. Push/Pulls: Comply with BHMA A156.6
 - 1. Provide push and pull on doors not specified to have lockset, latchset, exit device, or auxiliary lock.
 - 2. On solid doors, provide matching push plate and pull plate on opposite faces.
 - 3. On glazed storefront doors, provide matching push/pull bars on both faces.
 - 4. Provide Hospital type push/pull Latches
- B. Manufacturers:
 - 1. lves: www.allegion.com.
 - 2. Glynn-Johnson, an Allegion brand: www.allegion.com/us.
 - 3. Substitutions: See Section 01 6000 Product Requirements.
- C. Push/Pull Latches
 - 1. Backset: 2-3/4 inch unless otherwise indicated.
 - 2. Non handed, reversible mounting positions.
 - 3. Short throw angle, allowing the door to be opened with an easy push or pull action, even when hands are not free.
 - Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
 a. Finish: To match lock or latch.

2.11 DOOR PULLS AND PUSH PLATES

- A. Manufacturers:
 - 1. lves: www.allegion.com.
 - 2. Rockwood; an Assa Abloy Group company: www.assaabloydss.com.
 - 3. Hager Companies: www.hagerco.com/#sle.
 - 4. Trimco: www.trimcohardware.com.
 - 5. Substitutions: See Section 01 6000 Product Requirements.
- B. Door Pulls and Push Plates: Comply with BHMA A156.6.
 - 1. Pull Type: Straight, unless otherwise indicated.
 - Push Plate Type: Flat, with square corners, unless otherwise indicated.
 a. Edges: Beveled, unless otherwise indicated.
 - 3. Material: Stainless steel, unless otherwise indicated.

2.12 DOOR PULLS AND PUSH BARS

- A. Manufacturers:
 - 1. Ives: www.allegion.com.
 - 2. Rockwood; an Assa Abloy Group company: www.assaabloydss.com.
 - 3. Hager Companies: www.hagerco.com/#sle.
 - 4. Trimco: www.trimcohardware.com.
 - 5. Substitutions: See Section 01 6000 Product Requirements.
- B. Door Pulls and Push Bars: Comply with BHMA A156.6.
 - 1. Bar Type: Bar set, unless otherwise indicated.
 - 2. Material: Stainless steel, unless otherwise indicated.

2.13 CLOSERS

- A. Manufacturers; Surface Mounted:
 - 1. Norton; an Assa Abloy Group company: www.assaabloydss.com.
- B. Closers: Comply with BHMA A156.4, Grade 1.
 - 1. Type: Surface mounted to door.
 - 2. Provide door closer on each exterior door.
 - 3. At corridor entry doors, mount closer on room side of door.
 - 4. At outswinging exterior doors, mount closer on interior side of door.

2.14 AUTOMATIC DOOR OPERATORS

- A. Manufacturers; Surface Mounted:
 - 1. Norton; an Assa Abloy Group company: www.assaabloydss.com.
- B. Automatic Door Operators; Surface Mounted
 - 1. At corridor entry doors, mount operator on room side of door unless otherwise shown.
 - 2. Wired actuators: Recessed circular style. Mounted on each side of door. Verify final location with Architect.
 - 3. Control sequence for operators on doors with electric strikes and access control systems:
 - a. Interior actuator (ADA button): automatic door operator will swing open the door regardless of whether or not the electric strike is engaged (locked mode) when button is pressed. This will require the interior actuator receiver to act independently of the exterior actuator receiver to release the electric strike just prior to the operator engaging and opening the door.
 - b. Exterior actuator (ADA button): automatic door operator will only engage and open the door after an approved access badge is presented to the card reader and the electric strike is disengaged (unlocked mode).
 - c. Coordinate interface and operation with automatic door operator wiring installer.
 - 4. Control sequence for operators on doors with electric strikes:
 - a. Interior actuator (ADA button): automatic door operator will swing open the door regardless of whether or not the electric strike is engaged (locked mode) when button is pressed. This will require the interior actuator receiver to act independently of the exterior actuator receiver to release the electric strike just prior to the operator engaging and opening the door.
 - b. Exterior actuator (ADA button): automatic door operator will only engage and open the door if the mortise lock deadbolts is not thrown and the door is in the unlocked mode.
 - c. Coordinate interface and operation with automatic door operator wiring installer

2.15 OVERHEAD STOPS AND HOLDERS

- A. Manufacturers:
 - 1. Rixson or Sargent; an Assa Abloy Group company: www.assaabloydss.com.
 - 2. DORMA USA, Inc; 900 Series: www.dorma.com/#sle.
 - 3. Glynn-Johnson, an Allegion brand: www.allegion.com/us.
 - 4. Substitutions: See Section 01 6000 Product Requirements.
- B. Overhead Stops and Holders (Door Checks): Comply with BHMA A156.8, Grade 1.

2.16 PROTECTION PLATES

- A. Manufacturers:
 - 1. Rockwood; an Assa Abloy Group company: www.assaabloydss.com.
 - 2. Hager Companies: www.hagerco.com/#sle.
 - 3. Ives, an Allegion brand: www.allegion.com/us.
 - 4. Trimco: www.trimcohardware.com.
 - 5. Substitutions: See Section 01 6000 Product Requirements.
- B. Protection Plates: Comply with BHMA A156.6.

- C. Metal Properties: Stainless steel.
 - 1. Metal, Heavy Duty: Thickness 0.062 inch, minimum.
- D. Edges: Beveled, on four sides unless otherwise indicated.
- E. Fasteners: Countersunk screw fasteners.
- F. Drip Guard: Provide at head of exterior doors unless covered by roof or canopy.

2.17 KICK PLATES

- A. Manufacturers:
 - 1. Ives, an Allegion brand: www.allegion.com/us.
 - 2. Trimco: www.trimcohardware.com.
 - 3. Substitutions: See Section 01 6000 Product Requirements.
- B. Kick Plates: Provide along bottom edge of push side of every door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.
 - 1. Size: 10 inch high by 2 inch less door width (LDW) on push side of door.
 - 2. Provide two kickplates on each side of all restroom doors.

2.18 WALL STOPS

- A. Manufacturers:
 - 1. Rockwood; an Assa Abloy Group company: www.assaabloydss.com.
 - 2. Ives, an Allegion brand: www.allegion.com/us.
 - 3. Trimco: www.trimcohardware.com.
 - 4. Substitutions: See Section 01 6000 Product Requirements.
- B. Wall Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
 - 1. Provide wall stops to prevent damage to wall surface upon opening door.
 - 2. Type: Bumper, concave, wall stop.
 - 3. Material: Stainless steel housing with rubber insert.
 - 4. If wall stops are not practical, due to configuration of room or furnishings, provide overhead stop.

2.19 THRESHOLDS

- A. Manufacturers:
 - 1. Pemko; an Assa Abloy Group company: www.assaabloydss.com.
 - 2. National Guard Products, Inc: www.ngpinc.com.
 - 3. Zero International, Inc: www.zerointernational.com.
 - 4. Substitutions: See Section 01 6000 Product Requirements.
- B. Thresholds: Comply with BHMA A156.21.
 - 1. Provide threshold at each exterior door, unless otherwise indicated.
 - 2. Type: Interlocking.
 - 3. Material: Aluminum.
 - 4. Threshold Surface: Fluted horizontal grooves across full width.
 - 5. Field cut threshold to profile of frame and width of door sill for tight fit.
 - 6. Provide non-corroding fasteners at exterior locations.

2.20 WEATHERSTRIPPING AND GASKETING

- A. Manufacturers:
 - 1. Pemko; an Assa Abloy Group company: www.assaabloydss.com.
 - 2. Hager Companies: www.hagerco.com/#sle.
 - 3. Ives, an Allegion brand: www.allegion.com/us.
 - 4. National Guard Products, Inc: www.ngpinc.com.
 - 5. Zero International, Inc: www.zerointernational.com.
 - 6. Substitutions: See Section 01 6000 Product Requirements.
- B. Weatherstripping and Gasketing: Comply with BHMA A156.22.

- 1. Head and Jamb Type: Adjustable.
- 2. Door Sweep Type: Encased in retainer.
- 3. Material: Aluminum, with brush weatherstripping.
- 4. Provide weatherstripping on each exterior door at head, jambs, and meeting stiles of door pairs, unless otherwise indicated;
- 5. Provide door bottom sweep on each exterior door, unless otherwise indicated.

2.21 GATE LATCH

- A. Gate Latch: Provide to secure a gate used for traffic control to prevent pedestrian traffic into an area, located on inside of gate with turn piece.
 - 1. Material: Brass.

2.22 PADLOCKS

- A. Manufacturers:
 - 1. Basis of Design: Sargent.
 - 2. Substitutions: See Section 01 6000 Product Requirements.
- B. Padlocks: Solid extruded brass case with shackle that locks at heel and toe.
 - 1. Shackle Height: 3/4 inch, and width of opening is 7/8 inch.
 - 2. Shackle Diameter: 1/4 inch.

2.23 LATCH PROTECTOR

- A. Latch Protector: Provide on door to protect latch from being tampered with while in locked position.
 - 1. Type: Standard latch protector.
 - 2. Material: Stainless steel.

2.24 SIGNAGE

A. Provide all code compliant signage required at electrically operated doors.

2.25 SILENCERS

- A. Manufacturers:
 - 1. Ives, an Allegion brand: www.allegion.com/us.
 - 2. Rockwood; an Assa Abloy Group company: www.assaabloydss.com.
 - 3. Substitutions: See Section 01 6000 Product Requirements.
- B. Silencers: Provide at equal locations on door frames without seals or gaskets to mute sound of door's impact upon closing.
 - 1. Single Door: Provide three on strike jamb of frame.
 - 2. Pair of Doors: Provide two on head of frame, one for each door at latch side.
 - 3. Material: Rubber, gray color.

2.26 FIRE DEPARTMENT LOCK BOX

- A. Fire Department Lock Box:
 - 1. Specified under Section 10 4400 Fire Protection Specialties.

2.27 POWER SUPPLY

- A. Manufacturers:
 - 1. Substitutions: See Section 01 6000 Product Requirements.
- B. Power Supply: Hard wired, with multiple zones providing eight (8) breakers for each output panel with individual control switches and LED's; UL (DIR) Class 2 listed.
 - 1. Power: 24 VAC, 10 Amp; with 120 VAC power supply.
 - 2. Operating Temperature: 32 to 110 degrees F.
 - 3. Provide with emergency release terminals that release devices upon activation of fire alarm system.

2.28 FINISHES

A. Finishes: Provide door hardware of same finish, unless otherwise indicated.

- 1. Primary Finish: 625; bright chromium plated over nickel, with brass or bronze base material (former US equivalent US26); BHMA A156.18.
- 2. Secondary Finish: 626; satin chromium plated over nickel, with brass or bronze base material (former US equivalent US26D); BHMA A156.18.
 - a. Use secondary finish in kitchens, bathrooms, and other spaces containing chrome or stainless steel finished appliances, fittings, and equipment; provide primary finish on one side of door and secondary finish on other side if necessary.
- 3. Exceptions:
 - a. Where base material metal is specified to be different, provide finish that is an equivalent appearance in accordance with BHMA A156.18.
 - b. Hinges for Fire-Rated Doors: Steel base material with painted finish, in compliance with NFPA 80.
 - c. Door Closer Covers and Arms: Color as selected by Architect from manufacturer's standard colors unless otherwise indicated.
 - d. Aluminum Surface Trim and Gasket Housings: Anodized to match door panel finish, not other hardware, unless otherwise indicated.
 - e. Hardware for Aluminum Entrance Doors: Finished to match door panel finish, except at hand contact surfaces provide stainless steel with satin finish, unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.
- B. Verify that electric power is available to power operated devices and of correct characteristics.

3.02 INSTALLATION

- A. Install hardware in accordance with manufacturer's instructions and applicable codes.
- B. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.
- C. Use templates provided by hardware item manufacturer.
- D. Do not install surface mounted items until application of finishes to substrate are fully completed.
- E. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list; unless noted otherwise in Door Hardware Schedule or on drawings.
 - 1. For Steel Doors and Frames: Install in compliance with DHI (LOCS) recommendations.
 - 2. For Wood Doors: Install in compliance with DHI WDHS.3 recommendations.
- F. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.
 - 1. Refer to Section 07 9200 for additional requirements.

3.03 FIELD QUALITY CONTROL

- A. Perform field inspection and testing under provisions of Section 01 4000 Quality Requirements.
- B. Provide an Architectural Hardware Consultant (AHC) to inspect installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

3.04 ADJUSTING

- A. Adjust work under provisions of Section 01 7000 Execution and Closeout Requirements.
- B. Adjust hardware for smooth operation.

- C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.
- D. Test and adjust all Locks and Latches, including Lock Keyways for smooth and easy operation.

3.05 CLEANING

- A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.
- B. Clean adjacent surfaces soiled by hardware installation.
- C. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

3.06 PROTECTION

- A. Protect finished Work under provisions of Section 01 7000 Execution and Closeout Requirements.
- B. Do not permit adjacent work to damage hardware or finish.

3.07 SCHEDULE - ATTACHED IN SECTION 08 7110

END OF SECTION

SECTION 08 7110 DOOR HARDWARE SCHEDULE

MANUFACTURERS SPECIFIED:

PRODUCT	MANUFACTURER	SYMBOL
SPECIFIED	NAME	SPECIFIED
HINGES	MCKINNEY	MCK
LOCKSETS	SARGENT	SAR
CYLINDERS	SCHLAGE	SCH
EXIST DEVICES	VON DUPRIN	VD
PULLS	TRIMCO	TRI
CLOSERS	LCN	LCN
OPERATORS	LCN	LCN
KICKPLATES	TRIMCO	TRI
STOPS	IVES	IVES
THRESHOLDS	РЕМКО	PEMKO
SEALS	STEELCRAFT	STE
ELEC. STRIKES	HES ASSA ABLOY	HES
FLUSH BOLTS	ROCKWOOD	ROCK

- 1. Keying: Owner uses Schlage Open Classic keying system. Coordinate specific requirements with owner for cylinder compatibility with existing system. Provide construction cylinders on exterior doors. Assist Owner with keying requirements to extent proprietary system allows.
- 2. It is the hardware supplier's responsibility to provide all parts to make operational and functional door assemblies.

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GROUP 1 - EXTERIOR STOREFRONT ADA ENTRY

DOORS: 100A, 114A

QTY.	,	DESCRIPTION	FINISH	MANUF.
1	EA	ALUMINUM CONTINUOUS GEARED ELECTRIC HINGE - ACC	628	MCK
1	EA	EXIT DEVICE QEL98NL	630	VD
1	EA	CYLINDER – FSIC – HIGH-SECURITY		SCH
1	EA	DOOR OPERATOR 4640 – PUSH SIDE HEAD MOUNT	689	LCN
		(PROVIDE ANY/ALL MOUNTING PLATES REQUIRED)		
1	EA	DOOR ACTUATOR – WALL @ EXTERIOR – 8310-3836T	630	LCN
1	EA	DOOR ACTUATOR – WALL @ INTERIOR - 8310-853T	630	LCN
1	EA	KICKPLATE – 8" TALL X DOOR WIDTH LESS 2"	630	TRIMCO
1	SET	SEALS BY STOREFRONT SUPPLIER	BLACK	
1	EA	OVERHEAD RAIN DRIP #346	628	PEMKO
1	EA	DOOR BOTTOM SWEEP 345_v	628	PEMKO
1	EA	THRESHOLD 271A (VERIFY DETAIL REQUIRED)	628	PEMKO

NOTES:

- 1. PROVIDE ALL REQUIRED POWER SUPPLIES, WIRING HARNESSES, AND CONNECTIONS TO MAKE ELECTRIFIED HARDWARE FULLY FUNCTIONAL.
- 2. PROVIDE COMPATIBLE WIRING CONNECTIONS FROM DOOR HARDWARE TO ACCESS CONTROL SYSTEM SIGNAL CABLE CONNECTION POINT.
- 3. INTERTIE DOOR ACTUATORS, OPERATOR AND ACCESS CONTROL SO THAT EXTERIOR DOOR ACTUATOR IS DISABLED WHEN ACCESS CONTROL COMMANDS DOOR TO BE SECURE. INTERIOR DOOR ACTUATOR TO OPEN/UNLATCH DOOR HARDWARE FIRST AND THEN ENGAGE DOOR OPERATOR.

GROUP 2 – EXTERIOR HOLLOW METAL DOOR

DOORS: 125A, G002

QTY.		DESCRIPTION	FINISH	MANUF.
3	EA	HINGES STAINLESS 5BB1HW 4.5 x 4.5 NRP	630	IVES
1	EA	LOCKSET 63-FW-10G04 LL (STOREROOM)	626	SARGENT
1	EA	ELECTRIFIED STRIKE 6111		VD
1	EA	CYLINDER – FSIC – HIGH-SECURITY	626	SCH
1	EA	CLOSER 4020-3049 (HOLD OPEN ARM, PUSH SIDE MOUNT)	626	LCN
1	EA	KICKPLATE – 10" TALL X DOOR WIDTH LESS 2"	630	TRIMCO
1	SET	SEALS	BLACK	STE
1	EA	OVERHEAD STOP - OH104S	630	ROCK
1	EA	OVERHEAD RAIN DRIP #346	613	PEMKO
1	EA	DOOR BOTTOM SWEEP 345_v	613	PEMKO
1	EA	THRESHOLD 271A (VERIFY DETAIL REQUIRED)	ALUM	PEMKO

GROUP 3 – INTERIOR ENTRANCE

DOO	RS:	100B, 100C		
QTY. DESCRIPTION		FINISH	MANUF.	
3	ΕA	HINGES TB2714 4.5 x 4.5 NRP	630	MCK
1	ΕA	EXIT DEVICE LD-98-L-DT	626	VD
1	ΕA	CYLINDER – FSIC – HIGH-SECURITY	626	SCH
1	EA	ELECTRIC STRIKE 1006 J FACEPLATE	630	HES

DOOR HARDWARE SCHEDULE

1	EA	DOOR OPERATOR 4630 – PULL SIDE HEAD MOUNT (PROVIDE ANY/ALL MOUNTING PLATES REQUIRED)	689	LCN
1	EA	DOOR ACTUATOR – WALL @ INTERIOR - 8310-853	630	LCN
1	EA	DOOR ACTUATOR – WALL @ EXTERIOR - 8310-853	630	LCN
2	EA	KICKPLATE – 10" TALL X DOOR WIDTH LESS 2"	630	TRIMCO
1	EA	WALL STOP WS407CCV	626	IVES

NOTES:

- 1. PROVIDE ALL REQUIRED POWER SUPPLIES, WIRING HARNESSES, AND CONNECTIONS TO MAKE ELECTRIFIED HARDWARE FULLY FUNCTIONAL.
- 2. PROVIDE COMPATIBLE WIRING CONNECTIONS FROM DOOR HARDWARE TO ACCESS CONTROL SYSTEM SIGNAL CABLE CONNECTION POINT.
- 3. INTERTIE DOOR ACTUATORS, OPERATOR AND ACCESS CONTROL SO THAT DOOR ACTUATOR ON SECURE SIDE IS DISABLED WHEN ACCESS CONTROL COMMANDS DOOR TO BE SECURE. INTERIOR DOOR ACTUATOR TO OPEN/UNLATCH DOOR HARDWARE FIRST AND THEN ENGAGE DOOR OPERATOR.

GROUP 4 – OFFICE – FIRST FLOOR

DOORS: 108A, 110A, 112A, 128A

QTY.		DESCRIPTION	FINISH	MANUF.
3	EA	HINGES TA2714 4.5 x 4.5 NRP	626	MCK
1	EA	LOCKSET 63-10G05 LL (OFFICE)	626	SARGENT
1	EA	CYLINDER – FSIC – HIGH-SECURITY	626	SCH
1	EA	KICKPLATE – 10" TALL X DOOR WIDTH LESS 2"	630	TRIMCO
1	EA	WALL STOP WS407CCV	626	IVES
1	SET	SEALS	BLACK	STE

GROUP 5 – OFFICE – SECOND FLOOR

DOORS: 202A, 208A, 210A, 212A, 213A, 218A, 218B

<u>QTY</u>	QTY. DESCRIPTION		FINISH	MANUF.
3	EA	HINGES TA2714 4.5 x 4.5 NRP	626	MCK
1	EA	LOCKSET 63-10G05 LL (OFFICE)	626	SARGENT
1	EA	CYLINDER – FSIC – HIGH-SECURITY	626	SCH
1	EA	WALL STOP WS407CCV	626	IVES
1	SET	SEALS	BLACK	STE

GROUP 6 – CONFERENCE ROOM

DOORS: 205A, 205B

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QTY	′ .	DESCRIPTION	FINISH	MANUF.
3	EA	HINGES TB2714 4.5 x 4.5 NRP	626	MCK
1	EA	LOCKSET 63-10G37 LL (CLASSROOM)	626	SARGENT
1	EA	CYLINDER – FSIC – HIGH-SECURITY	626	SCH
1	EA	WALLSTOP WS407CCV	626	IVES
1	SET	SEALS	BLACK	STE

GROUP 7 – PASSAGE

DOORS: 102A

QTY. DESCRIPTION		DESCRIPTION	FINISH	MANUF.
3	EA	HINGES TA2714 4.5 x 4.5 NRP	626	MCK
1	EA	LOCKSET 10U15 LL (PASSAGE)	626	SARGENT
1	EA	KICKPLATE – 10" TALL X DOOR WIDTH LESS 2"	630	TRIMCO
1	EA	WALL STOP WS407CCV	626	IVES
1	SET	SEALS	BLACK	STE

GROUP 8 – SECURE STORAGE – SINGLE LEAF

DOORS: 104A, 107A, 129A, 225A

QTY.		DESCRIPTION	FINISH	MANUF.
3	EA	HINGES TA2714 4.5 x 4.5 NRP	626	MCK
1	EA	LOCKSET 63-10G04 LL (STOREROOM)	626	SARGENT
1	EA	CYLINDER – FSIC – HIGH-SECURITY	626	SCH
1	EA	KICKPLATE – 10" TALL X DOOR WIDTH LESS 2"	630	TRIMCO
1	EA	WALL STOP WS407CCV	626	IVES

GROUP 9 – SECURE STORAGE – DOUBLE LEAF

DOORS: 108B, 119A

QTY.	DESCRIPTION	FINISH	MANUF.
6 EA	HINGES TA2714 4.5 x 4.5 NRP	626	MCK
1 EA	LOCKSET 63-10G04 LL (STOREROOM)	626	SARGENT
1 EA	CYLINDER – FSIC – HIGH-SECURITY	626	SCH
2 EA	KICKPLATE – 10" TALL X DOOR WIDTH LESS 2"	630	TRIMCO
1 EA	FLUSHBOLTS	626	ROCK
2 EA	WALL STOP WS407CCV	626	IVES
1 EA 2 EA 1 EA 2 EA	CYLINDER – FSIC – HIGH-SECURITY KICKPLATE – 10" TALL X DOOR WIDTH LESS 2" FLUSHBOLTS WALL STOP WS407CCV	626 630 626 626	SCH TRIMC ROCK IVES

GROUP 10 – STORAGE – DOUBLE LEAF

DOORS: 216B

<u>QTY.</u>	QTY. DESCRIPTION		FINISH	MANUF.
6	EA	HINGES TA2714 4.5 x 4.5 NRP	626	MCK
2	EA	LOCKSET NB-7015 LL (PASSAGE, LBR)	626	SARGENT
2	EA	KICKPLATE – 10" TALL X DOOR WIDTH LESS 2"	630	TRIMCO
2	EA	WALL STOP WS407CCV	626	IVES

GROUP 11 – ELECTRICAL

DOORS: 106A

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GROUP 12 – INTERIOR EF / IDF

DOORS: 125B

QTY.		DESCRIPTION	FINISH	MANUF.
3	EA	HINGES TA2714 4.5 x 4.5 NRP	626	MCK
1	EA	LOCKSET 63-10F87 LL (UTILITY)	626	SARGENT
2	EA	CYLINDER – FSIC – HIGH-SECURITY	626	SCH
1	EA	ELECTRIC STRIKE 1006 J FACEPLATE	630	HES
1	EA	KICKPLATE – 10" TALL X DOOR WIDTH LESS 2"	630	TRIMCO
1	EA	CLOSER 4020-3077 (REGULAR ARM, PUSH SIDE MOUNT)	626	LCN
1	EA	WALL STOP WS407CCV	626	IVES
1	SET	SEALS	BLACK	STE

NOTES:

- 1. PROVIDE ALL REQUIRED POWER SUPPLIES, WIRING HARNESSES, AND CONNECTIONS TO MAKE ELECTRIFIED HARDWARE FULLY FUNCTIONAL.
- 2. PROVIDE COMPATIBLE WIRING CONNECTIONS FROM DOOR HARDWARE TO ACCESS CONTROL SYSTEM SIGNAL CABLE CONNECTION POINT.

GROUP 13 – MECHANICAL – DOUBLE LEAF

DOORS: 227A

QTY.		DESCRIPTION	FINISH	MANUF.
6	EA	HINGES TA2714 4.5 x 4.5 NRP	626	MCK
1	EA	LOCKSET 63-10G04 LL (STOREROOM)	626	SARGENT
1	EA	CYLINDER – FSIC – HIGH-SECURITY	626	SCH
1	EA	FLUSHBOLTS	626	ROCK
2	EA	AUTOMATIC DOOR BOTTOM – 4301_PKL SEMI-MORTISE	628	PEM
2	EA	OVERHEAD STOP - OH104S	630	ROCK
2	EA	KICKPLATE – 10" TALL X DOOR WIDTH LESS 2"	630	TRIMCO
2	EA	SPLIT ASTRAGAL SEALS	626	PEMKO
1	SET	SEALS	BLACK	STE

GROUP 14 – SINGLE-OCCUPANT ROOM

DOORS: 118A, 123A, 124A, 223A, 224A

QTY.		DESCRIPTION	FINISH	MANUF.
3	EA	HINGES T4B3786 4.5 X 4.5 NRP	626	MCK
1	EA	LOCKSET 63-L9496-17 (PRIVACY W/ INDICATOR)	626	SARGENT
1	EA	CYLINDER – FSIC – HIGH-SECURITY	626	SCH
1	EA	WALL STOP WS407CCV	626	IVES
2	EA	KICKPLATE – 10" TALL X DOOR WIDTH LESS 2"	630	TRIMCO
1	SET	SEALS	BLACK	STE

GROUP 15 – RESTROOM

DOORS: 120A, 121A

QTY.		DESCRIPTION	FINISH	MANUF.
3	EA	HINGES T4B3786 4.5 X 4.5 NRP	626	MCK
1	EA	PUSH PLATE 8200 6 X 16	630	IVES
1	EA	PULL PLATE 8302 6 X 16	630	IVES
1	EA	CLOSER 4030-3077 (REGULAR ARM, PULL SIDE MOUNT)	626	LCN
2	EA	KICKPLATE – 10" TALL X DOOR WIDTH LESS 2"	630	TRIMCO
1	EA	OVERHEAD STOP - OH104S	630	ROCK
1	SET	SEALS	BLACK	STE

GROUP 16 – EXERCISE ROOM

DOORS: 116A

QTY.		DESCRIPTION	FINISH	MANUF.
3	EA	HINGES T4B3786 4.5 X 4.5 NRP	626	MCK
1	EA	PUSH PLATE 8200 6 X 16	630	IVES
1	EA	PULL PLATE 8302 6 X 16	630	IVES
1	EA	CLOSER 4030-3077 (REGULAR ARM, PULL SIDE MOUNT)	626	LCN
2	EA	KICKPLATE – 10" TALL X DOOR WIDTH LESS 2"	630	TRIMCO
1	EA	WALL STOP WS407CCV	626	IVES
1	SET	SEALS	BLACK	STE

GROUP 17 – ELEVATOR ACCESS

DOO	RS: E1B			
QTY.		DESCRIPTION	FINISH	MANUF.
3	EA	HINGES TA2714 4.5 x 4.5 NRP	626	MCK
1	EA	LOCKSET SF-10G04 LL (STOREROOM)	626	SARGENT
1	EA	CYLINDER – FSIC – HIGH-SECURITY	626	SCH
1	EA	WALL STOP WS407CCV	626	IVES
1	SET	SEALS	BLACK	STE

GROUP 18 – TRAINING ROOM – SECOND FLOOR

DOORS: 216A, 216C

QTY.		DESCRIPTION	FINISH	MANUF.	
3	EA	HINGES TA2714 4.5 x 4.5 NRP	626	MCK	
1	EA	EXIT DEVICE 98-L	630	VD	
1	EA	CYLINDER – FSIC – HIGH-SECURITY	626	SCH	
1	EA	CLOSER 4030-3077 (REGULAR ARM, PULL SIDE MOUNT)	626	LCN	
1	EA	WALL STOP WS407CCV	626	IVES	
2	EA	KICKPLATE – 10" TALL X DOOR WIDTH LESS 2"	630	TRIMCO	
1	SET	SEALS	BLACK	STE	

GROUP 19 – SITE GATE

DOORS: EXT-1

QTY.		DESCRIPTION	FINISH	MANUF.
1	SET	GATE PIVOT/CLOSER MAMMOTH 180	AL	LOC
1	EA	EXIT DEVICE LD-98NL-WH	630	VD
1	EA	CYLINDER – FSIC – HIGH-SECURITY	626	SCH
1	EA	ELECTRIC STRIKE 6300 FSE 12/24 VAC/VDC	630	VON
1	EA	SILENCER SR66	BLACK	IVES

NOTES:

- 1. PROVIDE ALL REQUIRED POWER SUPPLIES, WIRING HARNESSES, AND CONNECTIONS TO MAKE ELECTRIFIED HARDWARE FULLY FUNCTIONAL.
- 2. PROVIDE COMPATIBLE WIRING CONNECTIONS FROM DOOR HARDWARE TO ACCESS CONTROL SYSTEM SIGNAL CABLE CONNECTION POINT.
- 3. INTERTIE DOOR ACTUATORS, OPERATOR AND ACCESS CONTROL SO THAT EXTERIOR DOOR ACTUATOR IS DISABLED WHEN ACCESS CONTROL COMMANDS DOOR TO BE SECURE. INTERIOR DOOR ACTUATOR TO OPEN/UNLATCH DOOR HARDWARE FIRST AND THEN ENGAGE DOOR OPERATOR.
- 4. MOUNT PANIC DEVICES AT 48 INCHES ABOVE FINISH GRADE

GROUP 20 – PARKING STRUCTURE ELECTRICAL ROOM

DOORS: G001

<u>QTY.</u>		DESCRIPTION	FINISH	MANUF.
3	EA	HINGES STAINLESS 5BB1HW 4.5 x 4.5 NRP	630	IVES
1	EA	EXIT DEVICE 63-8813 LL	626	SARGENT
1	EA	CYLINDER – FSIC – HIGH-SECURITY	626	SCH
1	EA	CLOSER 4020-3049 (HOLD OPEN ARM, PUSH SIDE MOUNT)	626	LCN
1	EA	KICKPLATE – 10" TALL X DOOR WIDTH LESS 2"	630	TRIMCO
1	SET	SEALS	BLACK	STE
1	EA	OVERHEAD STOP - OH104S	630	ROCK
1	EA	OVERHEAD RAIN DRIP #346	613	PEMKO
1	EA	DOOR BOTTOM SWEEP 345_v	613	PEMKO
1	EA	THRESHOLD 271A (VERIFY DETAIL REQUIRED)	ALUM	PEMKO

END OF SCHEDULE

SECTION 08 8000 GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Glass.
- B. Glazing compounds and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 08 1113 Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.
- B. Section 08 4313 Aluminum-Framed Storefronts: Glazing furnished for aluminum storefront systems.
- C. Section 10 2800 Toilet, Bath, and Laundry Accessories: Framed mirrors.

1.03 REFERENCE STANDARDS

- A. 16 CFR 1201 Safety Standard for Architectural Glazing Materials; Current Edition.
- B. ASTM C1036 Standard Specification for Flat Glass; 2016.
- C. ASTM C1048 Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
- D. ASTM C1193 Standard Guide for Use of Joint Sealants; 2016.
- E. ASTM E1300 Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.
- F. ASTM E2190 Standard Specification for Insulating Glass Unit Performance and Evaluation; 2010.
- G. GANA (GM) GANA Glazing Manual; 2008.
- H. GANA (SM) GANA Sealant Manual; 2008.
- I. OSSC Oregon Structural Specialty Code Latest edition

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data on Glass Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
- C. Samples: Submit two samples 12 by 12 inch in size of glass units, showing coloration and design.
- D. Certificates: Certify that products meet or exceed specified requirements.
- E. Manufacturer's Certificate: Certify that sealed insulated glass meets or exceeds specified requirements.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA Glazing Manual and GANA Sealant Manual for glazing installation methods.
- B. Perform Work in accordance with GANA Glazing Manual and FGMA Sealant Manual for glazing installation methods.
- C. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.
- D. Safety glazing to comply with OSSC requirements.

1.06 MOCK-UP

- A. Provide mock-up of storefront system including glass and air barrier and vapor retarder seal.
- B. Locate where indicated on drawings.
- C. Mock-up may remain as part of the Work.

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1.07 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 50 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.08 WARRANTY

- A. See Section 01 7800 Closeout Submittals, for additional warranty requirements.
- B. 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.

PART 2 PRODUCTS

2.01 INSULATING GLASS UNITS

- A. Type 1 Sealed Insulating Glass Units
 - 1. Application(s): North and east facing exterior glazing.
 - 2. Outboard Lite: PPG Starphire, Annealed float glass, 1/4 inch thick, minimum.
 - a. Tint: Clear.
 - b. Coating: PPG Solarban 60 Low-E type, on #2 surface.
 - 3. Spacer: 1/2" Aluminum poly
 - Inboard Lite: PPG Starphire, Annealed float glass, 1/4 inch thick, minimum.
 a. Tint: Clear.
 - 5. Total Thickness: 1 inch.
 - 6. Total Visible Light Transmittance: 74 percent, nominal.
 - 7. Total Solar Heat Gain Coefficient: 40 percent, nominal.
- B. Type 2 Sealed Insulating Glass Units
 - 1. Application(s): South facing exterior glazing.
 - 2. Outboard Lite: PPG Starphire, Annealed float glass, 1/4 inch thick, minimum. a. Tint: Clear.
 - b. Coating: PPG Solarban 70XL Low-E type, on #2 surface.
 - 3. Spacer: 1/2" Aluminum poly
 - 4. Inboard Lite: Annealed float glass, 1/4 inch thick, minimum. a. Tint: Clear.
 - 5. Total Thickness: 1 inch.
- C. Type 3 Sealed Insulating Glass Units
 - 1. Application(s): West facing exterior glazing.
 - 2. Outboard Lite: PPG Starphire, Annealed float glass, 1/4 inch thick, minimum. a. Tint: Clear.
 - b. Coating: PPG Solarban 70XL Low-E type, on #2 surface.
 - 3. Spacer: 1/2" Aluminum poly
 - Inboard Lite: Annealed float glass, 1/4 inch thick, minimum.
 a. Tint: Clear.
 - 5. Total Thickness: 1 inch.
- D. Type 4 Single Vision Glazing
 - 1. Application(s): All interior glass unless otherwise noted.
 - 2. Lite: Annealed float glass, 1/4 inch thick, minimum.
 - a. Tint: Clear.
 - b. Coating: none
- E. Provide Tempered Safety Glass within any of the above Glazing Types where shown on drawings or where required by OSSC.

2.02 EXTERIOR GLAZING ASSEMBLIES

A. Performance Criteria: Select type and thickness of glass to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of glass.

- 1. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
- 2. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
- 3. Glass thicknesses listed are minimum.

2.03 GLASS MATERIALS

- A. Float Glass Manufacturers:
 - 1. AGC Flat Glass North America, Inc: www.na.agc-flatglass.com.
 - 2. Cardinal Glass Industries: www.cardinalcorp.com
 - 3. Guardian Industries Corp: www.sunguardglass.com.
 - 4. Pilkington North America Inc: www.pilkington.com/na.
 - 5. PPG Industries, Inc: www.ppgideascapes.com.
 - 6. Oldcastle BuildingEnvelope: www.obe.com
 - 7. Substitutions: Refer to Section 01 6000 Product Requirements.
- B. Float Glass: Provide float glass based glazing unless noted otherwise.
 - 1. Annealed Type: ASTM C1036, Type I Transparent Flat, Class 1 Clear, Quality-Q3.
 - 2. Safety glazing shall comply with CPSC 16 CFR 1201.
 - 3. Heat-Strengthened and Fully Tempered Types: ASTM C1048, Kind HS and Kind FT.
 - a. Heat strengthen glazing exposed to high temperatures caused by the reflection and/or absorption of solar heat, and/or when recommended by the glazing manufacturer, and/or when required by other items of this specification section.
 - b. Heat temper glazing when required by other items of this specification section, and/or the drawings, and/or the building code.
 - c. Heat treating process should minimize Roller Wave Distortion.
 - d. Orient the glass in the heat treating oven so that the roller waves are parallel to the ground plane of the building.
 - 4. Thicknesses: As indicated; for exterior glazing comply with requirements indicated for wind load design regardless of thickness indicated.

2.04 SEALED INSULATING GLASS UNITS

- A. Manufacturers:
 - 1. Any of the manufacturers specified for float glass.
 - 2. Substitutions: Refer to Section 01 6000 Product Requirements.
- B. Sealed Insulating Glass Units: Types as indicated.
 - 1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
 - 2. Edge Spacers: Aluminum, bent and soldered corners.
 - 3. Edge Seal: Glass to elastomer with supplementary silicone sealant.
 - 4. Purge interpane space with dry hermetic air.

2.05 GLAZING COMPOUNDS

A. As recommended by the glazing manufacturer for particular applications.

2.06 GLAZING ACCESSORIES

- A. As recommended by the glazing manufacturer for particular applications.
- B. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.
- C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; hardness range of 5 to 30 cured Shore A durometer; coiled on release paper; black color.
- D. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; black color.
PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that openings for glazing are correctly sized and within tolerance.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

3.02 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant.
- D. Install sealants in accordance with ASTM C1193 and GANA Sealant Manual.
- E. Install sealants in accordance with manufacturer's instructions.

3.03 INSTALLATION

A. Install in strict accordance with manufacturer's instructions and FGMA Glazing Manual.

3.04 INSTALLATION - EXTERIOR/INTERIOR DRY METHOD (GASKET GLAZING)

- A. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
- B. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- C. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.05 INSTALLATION - INTERIOR DRY METHOD (TAPE AND TAPE)

- A. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch above sight line.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
- C. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.
- D. Place glazing tape on free perimeter of glazing in same manner described above.
- E. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
- F. Knife trim protruding tape.

3.06 CLEANING

- A. Remove glazing materials from finish surfaces.
- B. Remove labels after Work is complete.
- C. Clean glass and adjacent surfaces.

3.07 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

SECTION 08 8723 DECORATIVE GLAZING FILMS

PART 1 - GENERAL

1.01 SUMMARY

A. Decorative Glazing Films.

1.02 RELATED REQUIREMENTS

A. Section 08 8000 - Glazing

1.03 REFERENCE STANDARDS

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

1.04 PERFORMANCE REQUIREMENTS

- A. Thermal and Optical Performance Properties: Provide glazing films with performance properties specified (on 1/8 inch clear glass) based on manufacturer's published test data, as determined according to procedures indicated in ASHRAE Handbook of Fundamentals:
 - 1. Performance requirements vary by product selected and will be identified by Architect from color selection samples submitted by the manufacturer.
- B. Surface Burning Characteristics: Provide films that have Flame Spread Index of 0 and Smoke Development Index of 30 or less when tested in accordance to ASTM E 84.
- C. Minimum Peel Strength: 2,000 grams per inch, average of two specimens when tested in accordance with ASTM D 3330.

1.05 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Samples for Color Selection: Manufacturer's standard sample sets showing the full range of colors available for each type of product indicated.
- C. Samples for Verification: 12-inch square samples of each glazing film, of each product color specified.
- D. Closeout Submittals: Upon completion of the Work, submit the following;
 - 1. Executed warranty.
 - 2. Maintenance (cleaning) and replacement instructions.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Engage a firm experienced in manufacturing systems similar to those indicated for this Project and meeting the standards of the International Standards Organization (ISO), ISO 9001 Quality Assurance in Production and Installation.
- B. Installer Qualifications: Engage an experienced installer certified, licensed, or otherwise qualified by film manufacturer as having the necessary experience, staff, and training to install manufacturer's products according to specified requirements.
- C. Pre-installation Conference: Before installing glazing films, conduct conference at Project site. Conduct pre-installation conference in conjunction with installation of mockup.
 - 1. Meet with Owner, Architect, glazing film Installer and glazing film manufacturer's representative.
 - 2. Review methods and procedures related to installation, including manufacturer's written instructions.
 - 3. Examine substrate conditions for compliance with requirements.
 - 4. Review temporary protection measures required during and after installation.

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5. Document proceedings, including corrective measures or actions required, and furnish copy of record to each participant.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing films according to manufacturer's written instructions and as needed to prevent damage condensation, temperature changes, direct exposure to sun, or other causes.

1.08 PROJECT CONDITIONS

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

1.09 WARRANTY

A. Manufacturer's Warranty: Fully executed warranty, written in favor of the Owner, agreeing to replace films that deteriorate as defined in "Definitions" Article, within 5 years from date of original installation.

PART 2 - PRODUCTS

2.01 GLAZING FILM

- A. Manufacturers:
 - 1. CPFilms Inc.; LLumar Films. www.llumar.com
 - 2. 3M Window Film: www.3m.com/us/arch_construct/scpd/windowfilm
 - 3. CPFilms, Inc: www.cpfindusprod.com www.cpfindusprod.com
 - 4. Madico, Inc: www.madico.com.
 - 5. Substitutions: See Section 01 6000 Product Requirements.
- B. Product Description: Single or multi-layered decorative film products, applied to interior glass surfaces, consisting of from outboard surface to inboard surface:
 - 1. Similar to "Fasara", by 3M.
 - 2. Removable release liner.
 - 3. Pressure sensitive adhesive with integral ultraviolet absorbers.
 - 4. Clear, dyed, or printed pattern layer of polyester film.
 - 5. Possible layer of metalized or sputtered polyester film.
 - 6. Possible scratch resistant coating.
- C. Pattern and Color: Selected by Architect from Manufacturer's standard color and pattern with the following characteristics.
 - 1. Type GF-1 Semitransparent pattern with gradation of transparency.

2.02 GLAZING FILM ACCESSORIES

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

PART 3 - EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

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

3.03 INSTALLATION

- A. General: Comply with glazing film manufacturers' written installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
 - 1. Install film continuously, but not necessarily in one continuous length. Install with no gaps or overlaps.
 - 2. If seamed, install with no gaps or overlaps. Install seams vertical and plumb. No horizontal seams allowed.
 - 3. Do not remove release liner from film until just before each piece of film is cut and ready for installation.
 - 4. Install film with mounting solution and custom cut to the glass with neat, square corners and edges to within 1/8 inch of the window frame.
 - 5. Remove air bubbles, wrinkles, blisters, and other defects.
- B. After installation, view film from a distance of 10 feet against a bright uniform sky or background. Film shall appear uniform in appearance with no visible streaks, banding, thin spots or pinholes.
 - 1. If installed film does not meet this criteria, remove and replace with new film.

3.04 CLEANING

- A. Remove excess mounting solution at finished seams, perimeter edges, and adjacent surfaces.
- B. Use cleaning methods recommended by glazing film manufacturer.
- C. Replace films that cannot be cleaned.

SECTION 09 2116 GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Acoustic insulation.
- B. Cementitious backing board.
- C. Gypsum wallboard.
- D. Joint treatment and accessories.
- E. Acoustical sealant.

1.02 RELATED REQUIREMENTS

- A. Section 01 6116 Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 05 4000 Cold-Formed Metal Framing: Structural steel stud framing.
- C. Section 07 2500 Weather Barriers: Water-resistive barrier over sheathing.
- D. Section 09 2216 Non-Structural Metal Framing.
- E. Section 09 3000 Tiling: Tile backing board.
- F. Section 09 9600 Painting: PVA primer/sealer on gypsum board.

1.03 REFERENCE STANDARDS

- A. ASTM C475/C475M Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017.
- B. ASTM C665 Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.
- C. ASTM C840 Standard Specification for Application and Finishing of Gypsum Board; 2019b.
- D. ASTM C1047 Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2019.
- E. ASTM C1396/C1396M Standard Specification for Gypsum Board; 2017.
- F. ASTM C1658/C1658M Standard Specification for Glass Mat Gypsum Panels; 2019.
- G. ASTM D3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- H. GA-216 Application and Finishing of Gypsum Panel Products; 2016.
- I. OSSC Oregon Structural Specialty Code; latest edition.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.
- C. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum 5 years of experience.

PART 2 PRODUCTS

2.01 BOARD MATERIALS

- A. Manufacturers Gypsum-Based Board:
 - 1. American Gypsum: www.americangypsum.com.
 - 2. Celotex.
 - 3. CertainTeed Corporation: www.certainteed.com/#sle.

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- 4. Domtar Gypsum America, Inc.
- 5. Georgia-Pacific Gypsum: www.gpgypsum.com.
- 6. National Gypsum Company: www.nationalgypsum.com.
- 7. PABCO Gypsum: www.pabcogypsum.com.
- 8. Temple-Inland Building Product by Georgia-Pacific, LLC: www.temple.com.
- 9. USG Corporation: www.usg.com.
- B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 1. Application: Use for vertical surfaces, unless otherwise indicated.
 - 2. Glass mat faced gypsum panels, as defined in ASTM C1658/C1658M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
 - 3. Type: Type X board, UL or WH listed.
 - 4. Thickness:
 - a. Vertical Surfaces: 5/8 inch.
 - b. Multi-Layer Assemblies: Thicknesses as indicated on drawings.
- C. Water-Resistant Gypsum Backing Board: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
 - 1. Application: Vertical surfaces behind thinset tile, except in wet areas.
 - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 3. Type: Type X, in locations indicated.
 - 4. Thickness: 5/8 inch.
 - 5. Edges: Tapered.
- D. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 1. Application: Ceilings, unless otherwise indicated.
 - 2. Thickness: 1/2 inch.
 - 3. Edges: Tapered.

2.02 GYPSUM WALLBOARD ACCESSORIES

- A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 3-1/2 inch.
 - 1. Certified by the Greenguard Environmental Institute under the Greenguard Standard for Low Emitting Products.
- B. Acoustic Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board; meeting project's VOC limits.
- C. Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
 1. Types: As detailed or required for finished appearance.
 - 2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.
- D. Reveals and Moldings:
 - 1. Expansion and Control Joints: Aluminum, similar to Fry Reglet DRM-50-50 2 piece.
 - 2. Reveal Molding: Aluminum, 5/8 inch deep, 1/2 inch wide, similar to Fry Reglet DRM 625-50.
- E. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
- F. Textured Finish Materials: Latex-based compound; plain.
- G. Screws for Fastening of Gypsum Panel Products to Wood Framing: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 ACOUSTIC ACCESSORIES INSTALLATION

- A. 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.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
 - 1. Place one bead continuously on substrate before installation of perimeter framing members.
 - 2. Place continuous bead at perimeter of each layer of gypsum board.
 - 3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.03 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
- C. Double-Layer, Nonrated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum board at exterior walls and at other locations as indicated. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.
- D. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- E. Installation on Wood Framing: For rated assemblies, comply with requirements of listing authority. For nonrated assemblies, install as follows:
 - 1. Single-Layer Applications: Screw attachment.

3.04 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.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.
- D. Reveal Moulding: Install in patterns as shown on drawings according to manufacturer's instructions, directly to wall framing, or base layer of wall board in multiple layer applications. Cutting in reveal molding after wall board installation is not acceptable.
- E. Wall and Ceiling Mounted Access Hatches: Coordinate size, location and number of access hatches shown to be provided in other specification sections or on the drawings. Install these access hatches in gypsum board walls and ceilings in accordance with manufacturer's instructions flat and smooth in wall and ceiling surfaces.

3.05 JOINT TREATMENT

- A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 - 1. Level 5: Walls to receive vinyl wall graphics and other areas specifically indicated.
 - 2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
 - 3. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
 - 4. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- B. 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.
- C. 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.

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3.06 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

SECTION 09 2216 NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal partition, ceiling, and soffit framing.
- B. Framing accessories.

1.02 RELATED REQUIREMENTS

A. Section 09 2116 - Gypsum Board Assemblies: Execution requirements for anchors for attaching work of this section.

1.03 REFERENCE STANDARDS

- A. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- B. ASTM C645 Standard Specification for Nonstructural Steel Framing Members; 2018.
- C. ASTM C754 Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2018.
- D. ASTM C1002 Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2018.
- E. SSPC-Paint 20 Zinc-Rich Coating (Type I Inorganic, and Type II Organic); 2019.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate prefabricated work, component details, stud layout, framed openings, anchorage to structure, acoustic details, type and location of fasteners, accessories, and items of other related work.
 - 2. Describe method for securing studs to tracks, splicing, and for blocking and reinforcement of framing connections.
- C. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.
- D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Framing, Connectors, and Accessories:
 - 1. ClarkDietrich: www.clarkdietrich.com/#sle.
 - 2. SCAFCO Corporation: www.scafco.com/#sle.
 - 3. Substitutions: See Section 01 6000 Product Requirements.

2.02 FRAMING MATERIALS

- 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.
 - 1. Studs: C shaped with knurled or embossed faces.
 - 2. Runners: U shaped, sized to match studs.
 - 3. Ceiling Channels: C shaped.

- 4. Minimum Metal Thickness
 - a. Adjacent to door jambs: 20 ga
 - b. At plywood wall coverings, wall panels: 20 ga
 - c. At backerboard to receive ceramic tile: 20 ga
 - d. Wall supporting metal ceiling framing: 20 Contractor to size
 - e. At walls taller than 11'-0" (unsupported height): 20 ga
 - f. Walls to support casework or plumbing fixtures: 20 ga
 - g. Walls to support TV brackets: 20 ga
 - h. Elsewhere: 25 ga
- B. Partition Head to Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and fastened as indicated on drawings.
 - 1. Two Piece Deflection Track: Upper track with 2 inch minimum flange, web dimension to slip over normal track allowing 1 1/2 inch deflection of structure. "VST" by Dale Incor, or approved.
 - Fire Rated Single Piece Deflection Track: One-piece top track allowing 1 1/2 inch deflection of structure. Shape and size as shown on Drawings. Provide with clip allowing slip connection of stud to track. "Fire Trak", and Trak Slip Clip" by Fire Track Corp., or approved.
 - 3. Slip Connection and Slide Clips: Curtain wall type clip allowing vertical slip connection of studs while providing lateral support.
- C. Non-Loadbearing Framing Accessories:
 - 1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
 - 2. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.
 - a. Products:
 - 1) ClarkDietrich; FastBridge Clip (FB33): www.clarkdietrich.com/#sle.
 - 2) Substitutions: See Section 01 6000 Product Requirements.
 - 3. Sheet Metal Backing: 0.036 inch thick, galvanized.
 - 4. Fasteners: ASTM C1002 self-piercing tapping screws.
 - 5. Anchorage Devices: Powder actuated or Drilled expansion bolts.
 - 6. Acoustic Insulation: As specified in Section 09 2116.
 - 7. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
 - 8. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I Inorganic.

2.03 FABRICATION

- A. Fabricate assemblies of framed sections to sizes and profiles required.
- B. Fit, reinforce, and brace framing members to suit design requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that rough-in utilities are in proper location.

3.02 INSTALLATION OF STUD FRAMING

- A. Comply with requirements of ASTM C754.
- B. Extend partition framing to structure or ceiling as indicated on drawings.
- C. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
- D. 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.

- E. Align and secure top and bottom runners at 24 inches on center.
- F. Where stud walls sit directly on recessed concrete slabs install a 1-1/2 inch thick pressure treated wood plate below, and matching the width of, the bottom runner. Secure to slab as noted on drawings.
- G. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
- H. Install studs vertically at 24 inches on center, unless otherwise noted here or on drawings.
 - 1. Studs at walls to receive tile finish to be 16 inches on center.
 - 2. Studs in walls that will support mirror, ballet barres, casework, and similar item to be 16 inches on center.
- I. Align stud web openings horizontally.
- J. Secure studs to tracks using fastener method. Do not weld.
- K. Stud splicing is not permissible.
- L. Fabricate corners using a minimum of three studs.
- M. Install double studs at wall openings, door and window jambs, not more than 2 inches from each side of openings.
- N. Brace stud framing system rigid.
- O. Coordinate erection of studs with requirements of door frames; install supports and attachments.
- P. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.
- Q. Blocking: Use steel channels secured to studs. Provide blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware, opening frames, and other accessories shown on drawings.
- R. Use sheet metal backing for reinforcement of wall where wall mounted items are shown on drawings..

3.03 INSTALLATION OF CEILING AND SOFFIT FRAMING

- A. Make provisions for erection stresses. Provide temporary alignment and bracing.
- B. Place joists at 12 inches o.c.; not more than 2 inches from abutting walls. Connect joists to supports using fastener method.
- C. Set ceiling and soffit joists parallel and level, with lateral bracing and bridging.
- D. Locate joist end bearing directly over load bearing studs or provide load distributing member to top of stud track.
- E. Coordinate framing with the work and products of other Sections. Provide framing for openings using standard framing techniques unless specifically detailed otherwise.

3.04 TOLERANCES

- A. Maximum Variation From True Position: 1/8 inch in 10 feet.
- B. Maximum Variation From Plumb: 1/8 inch in 10 feet.

SECTION 09 3000 TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Tile for shower receptors.
- D. Cementitious backer board as tile substrate.
- E. Ceramic trim.
- F. Non-ceramic trim.

1.02 RELATED REQUIREMENTS

- A. Section 07 9200 Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.
- B. Section 22 4000 Plumbing Fixtures:

1.03 REFERENCE STANDARDS

- A. ANSI A108/A118/A136 American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2019.
- B. ANSI A108.1a American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2017.
- C. ANSI A108.1b American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar; 2017.
- D. ANSI A108.1c Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Bed with Dry-Set or Latex-Portland Cement; 1999 (Reaffirmed 2016).
- E. ANSI A108.2 American National Standard General Requirements: Materials, Environmental and Workmanship; 2019.
- F. ANSI A108.4 American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive; 2009 (Revised).
- G. ANSI A108.5 American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
- H. ANSI A108.6 American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy; 1999 (Reaffirmed 2010).
- I. ANSI A108.8 American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2010).
- J. ANSI A108.9 American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 1999 (Reaffirmed 2010).
- K. ANSI A108.10 American National Standard Specifications for Installation of Grout in Tilework; 2017.
- L. ANSI A108.11 American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2018.
- M. ANSI A108.12 American National Standard for Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).

- N. ANSI A108.13 American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2016).
- O. ANSI A108.19 American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar; 2017.
- P. ANSI A118.3 American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 2013 (Revised).
- Q. ANSI A118.4 American National Standard Specifications for Modified Dry-Set Cement Mortar; 2012 (Revised).
- R. ANSI A118.10 American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes For Thin-Set Ceramic Tile And Dimension Stone Installation; 2014.
- S. ANSI A118.11 American National Standard Specifications for EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
- T. ANSI A118.12 American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2014.
- U. ANSI A118.15 American National Standard Specifications for Improved Modified Dry-Set Cement Mortar; 2012.
- V. ANSI A137.1 American National Standard Specifications for Ceramic Tile; 2019.
- W. ASTM C373 Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products; 2018.
- X. TCNA (HB) Handbook for Ceramic, Glass, and Stone Tile Installation; 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers.

1.05 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, and setting details.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 Product Requirements, for additional provisions.
 - 2. Extra Tile: 10 square feet of each size, color, and surface finish combination.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.
- B. Installer Qualifications: Company specializing in performing tile installation, with minimum of five years of documented experience.

1.07 MOCK-UP

A. See Section 01 4000 - Quality Requirements, for general requirements for mock-up.

- B. Construct tile mock-up where indicated on drawings, incorporating all components specified for the location.
 - 1. Minimum size of mock-up to be 100 square feet, including each trim type.
 - 2. Approved mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.09 FIELD CONDITIONS

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature above 50 degrees F and below 100 degrees F during installation and curing of setting materials.

PART 2 PRODUCTS

2.01 TILE

- A. Manufacturers:
 - 1. Dal-Tile Corporation: www.daltile.com/#sle.
 - 2. Emser Tile, LLC: www.emser.com/#sle.
 - 3. Substitutions: See Section 01 6000 Product Requirements.
- B. Porcelain Floor Tile, Type T-2:
 - 1. Moisture Absorption: 7.0 to 20.0 percent as tested in accordance with ASTM C373.
 - 2. Size: 24 inch, nominal.
 - 3. Surface Finish: Matte glaze.
 - 4. Color(s): As indicated on drawings.
 - 5. Pattern: As indicated on the drawings.
 - 6. Grout Joint: 1/8 inch
 - 7. Products:
 - a. Portfolio by Daltile.
 - b. Substitutions: See Section 01 6000 Product Requirements.
- C. Glazed Ceramic Wall Tile, Type T-1, T-3, T-4, T-5. T-6:
 - 1. Moisture Absorption: 7.0 to 20.0 percent as tested in accordance with ASTM C373.
 - 2. Size: Varies, as indicated on drawings.
 - 3. Surface Finish: Matte glaze.
 - 4. Color(s): As indicated on drawings.
 - 5. Pattern: As indicated on the drawings.
 - 6. Grout Joint: 1/8 inch
 - 7. Products:
 - a. Natural Hues by Daltile.
 - b. Substitutions: See Section 01 6000 Product Requirements.

2.02 TRIM AND ACCESSORIES

- A. Non-Ceramic Trim: Satin natural anodized extruded aluminum, style and dimensions to suit application, for setting using tile mortar or adhesive.
 - 1. Applications:
 - a. Open edges of floor tile, including at door openings:
 - 1) Same height transitions: similar to Schluter SCHIENE.
 - b. Wall corners, outside and inside:
 - 1) As indicated on drawings.
 - 2) Similar to Schluter JOLLY
 - c. Transition between floor finishes of different heights: similar to Schluter RENO-TK. Transition from floor tile to concrete to be ADA compliant.
 - d. Expansion and control joints, floor and wall: similar to Schluter DECO.
 - e. Floor to wall joints at areas with wall tile and tile floor:
 - 1) In locations as noted on the enlarged wall tile elevations and details.

- 2) Similar to Schluter DILEX-HKS
- 2. Manufacturers:
 - a. Schluter-Systems: www.schluter.com/#sle.
 - b. Genesis APS International: www.genesis-aps.com/#sle.
 - c. Profilitec: www.profilitec.com/en.
 - d. Substitutions: See Section 01 6000 Product Requirements.
- B. Grout Sealer (at Porcelain Tile): Type recommended by tile manufacturer; water based, penetrating.

2.03 SETTING MATERIALS

- A. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4.
 - 1. Applications: Use this type of bond coat where Large and Heavy Tile (LHT) mortar is indicated.
 - 2. Applications: Use this type of bond coat where indicated and where no other type of bond coat is indicated.
 - 3. Bond Coat must allow Large and Heavy Tile (LHT) to be sloped to floor drain.
 - 4. Products:
 - a. ARDEX Engineered Cements: www.ardexamericas.com/#sle.
 - b. Custom Building Products; ProLite Premium Rapid Setting Large Format Tile Mortar, with Multi-Surface Bonding Primer: www.custombuildingproducts.com/#sle.
 - c. Merkrete, by Parex USA, Inc; Merkrete 735 Premium Flex: www.merkrete.com/#sle.
 - d. TEC, an H.B. Fuller Construction Products Brand; TEC Ultimate Large Tile Mortar: www.tecspecialty.com/#sle.
 - e. LATICRETE International, Inc. www.laticrete.com.
 - f. Substitutions: See Section 01 6000 Product Requirements.
- B. Mortar Bond Coat For Exterior Glue Plywood: ANSI A118.11.
 - 1. Applications: Use this type of bond coat where Large and Heavy Tile (LHT) mortar is indicated.
 - 2. Bond Coat must allow Large and Heavy Tile (LHT) to be sloped to floor drain.
 - 3. Products:
 - a. ARDEX Engineered Cements; ARDEX X 5: www.ardexamericas.com/#sle.
 - b. Custom Building Products; Complete Contact-LFT Premium Rapid Setting Large Format Tile Mortar: www.custombuildingproducts.com/#sle.
 - c. LATICRETE International, Inc; LATICRETE 254 Platinum: www.laticrete.com/#sle.
 - d. Merkrete, by Parex USA, Inc; Merkrete 7D10 Dust Less Thin Set: www.merkrete.com/#sle.
 - e. Substitutions: See Section 01 6000 Product Requirements.

2.04 GROUTS

- A. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
 - 1. Applications: At all locations.
 - 2. Color(s): As selected by Architect from manufacturer's full line.
 - 3. Use sanded grout for joints 1/8 inch wide and larger; use unsanded grout for joints less than 1/8 inch wide.
 - 4. Products:
 - a. ARDEX Engineered Cements; ARDEX WA: www.ardexamericas.com/#sle.
 - b. Custom Building Products; CEG-IG 100% Solids Industrial Grade Epoxy Grout: www.custombuildingproducts.com/#sle.
 - c. LATICRETE International, Inc; LATICRETE SPECTRALOCK PRO Premium Grout: www.laticrete.com/#sle.
 - d. Merkrete, by Parex USA, Inc; Merkrete Pro Epoxy: www.merkrete.com/#sle.
 - e. TEC, an H.B. Fuller Construction Products Brand; TEC AccuColor EFX Epoxy Special Effects Grout: www.tecspecialty.com/#sle.
 - f. Substitutions: See Section 01 6000 Product Requirements.

2.05 MAINTENANCE MATERIALS

- A. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
 - 1. Applications: Between tile and plumbing fixtures.
 - 2. Color(s): As selected by Architect from manufacturer's full line.
 - 3. Products:
 - a. ARDEX Engineered Cements; ARDEX SX: www.ardexamericas.com/#sle.
 - b. Custom Building Products; Commercial 100% Silicone Caulk: www.custombuildingproducts.com/#sle.
 - c. LATICRETE International, Inc; LATICRETE LATASIL: www.laticrete.com/#sle.
- B. Grout Sealer: Liquid-applied, moisture and stain protection for Portland cement grout.
 - 1. Composition: Water-based colorless silicone.
 - 2. Products:
 - a. Merkrete, by Parex USA, Inc; Merkrete Grout Sealer: www.merkrete.com/#sle.

2.06 ACCESSORY MATERIALS

- A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; not intended as waterproofing.
 - 1. Thickness: 20 mils, maximum.
 - 2. Crack Resistance: No failure at 1/8 inch gap, minimum.
 - 3. Products:
 - a. LATICRETE International, Inc; LATICRETE Blue 92 Anti-Fracture Membrane: www.laticrete.com/#sle.
 - b. Merkrete, by Parex USA, Inc; Merkrete Fracture Guard: www.merkrete.com/#sle.
 - c. Substitutions: See Section 01 6000 Product Requirements.
- B. Waterproofing / Crack Isolation Membrane at Floors: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
 - 1. Crack Resistance: No failure at 1/8 inch gap, minimum; comply with ANSI A118.12.
 - 2. Fluid or Trowel Applied Type:
 - a. Material: Synthetic rubber or Acrylic.
 - b. Products:
 - 1) ARDEX Engineered Cements; ARDEX 8+9: www.ardexamericas.com/#sle.
 - 2) Custom Building Products; RedGard Crack Prevention and Waterproofing Membrane: www.custombuildingproducts.com/#sle.
 - 3) LATICRETE International, Inc; LATICRETE HYDRO BAN: www.laticrete.com/#sle.
 - 4) Substitutions: See Section 01 6000 Product Requirements.
- C. Waterproofing Membrane at Showers and Tiled Tubs: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
 - 1. Fluid or Trowel Applied Type:
 - a. Products:
 - 1) ARDEX Engineered Cements; ARDEX 8+9: www.ardexamericas.com/#sle.
 - 2) LATICRETE International, Inc; LATICRETE HYDRO BAN: www.laticrete.com/#sle.
 - 3) Substitutions: See Section 01 6000 Product Requirements.
- D. Vapor Retarder Membrane at Shower Tiled walls
- E. Underlayment at plywood subloors: Minimum 3/8" exterior-glue laminated birch wood panel with a minimum of 7 plies.
- F. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 1/2 inch thick; 2 inch wide coated glass fiber tape for joints and corners.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.
- D. Verify that sub-floor surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by tile manufacturer and setting materials manufacturer.
- E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.

3.03 INSTALLATION - GENERAL

- A. Install tile and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.19, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Form internal angles square and external angles bullnosed.
- F. Install non-ceramic trim in accordance with manufacturer's instructions.
- G. Sound tile after setting. Replace hollow sounding units.
- H. Keep control and expansion joints free of mortar, grout, and adhesive.
- I. Keep expansion joints free of adhesive or grout. Apply sealant to joints.
- J. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- K. Grout tile joints unless otherwise indicated. Use epoxy grout everywhere.
- L. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.
- M. Install grout sealer at grout joints of porcelain tile per tile and grout manufacturer's instructions.
- N. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

3.04 INSTALLATION - FLOORS - THIN-SET METHODS

- A. Use epoxy grout at all toilet rooms. Over Interior concrete substrates, install in accordance with TCNA (HB) Method F115A, with Epoxy grout.
 - 1. At large format tile intallation, provide medium bed with crack isolation membrane and epoxy grout.
- B. Over wood substrates, install in accordance with TCNA (HB) Method F160, with Epoxy grout, unless otherwise indicated.

3.05 INSTALLATION - FLOORS - MORTAR BED METHODS

- A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F112, bonded, unless otherwise indicated.
 - 1. Where epoxy or furan grout is indicated, but not epoxy or furan bond coat, install in accordance with TCNA (HB) Method F114, with cleavage membrane.
- B. Cleavage Membrane: Lap edges and ends.
- C. Mortar Bed Thickness: 1-1/4 inch, unless otherwise indicated.

3.06 INSTALLATION - SHOWERS WALLS

- A. At tiled shower walls install in accordance with TCNA (HB) Method B412, over cementitious backer units with waterproofing membrane.
 - 1. Vapor retarder membrane to be installed beind cementitious backer unit. Membrane must overlap shower base flange.
- B. Grout with epoxy grout as specified above.

3.07 INSTALLATION - WALL TILE

A. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244F, using membrane at toilet rooms.

3.08 CLEANING

A. Clean tile and grout surfaces.

3.09 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation, unless otherwise approved by manufacturer. Protect tile during curing process as recommended by manufacturer.

SECTION 09 5100 ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units for lay-in application.

1.02 RELATED REQUIREMENTS

- A. Section 01 6116 Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 21 0500 General Fire Protection Provisions
- C. Section 23 3713 Air Outlets and Inlets: Air diffusion devices in ceiling.
- D. Section 23 8245 Chilled Beam Systems
- E. Section 26 5100 Lighting Fixtures: Light fixtures in ceiling system.
- F. Section 28 3100 Fire Alarm System: Fire alarm components in ceiling system.

1.03 REFERENCE STANDARDS

- A. ASTM C423 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2017.
- B. ASCE 7-10 Minimum Design Loads for Buildings and Other Structures; American Society of Civil Engineers; current edition.
- C. ASTM C635/C635M Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2017.
- D. ASTM C636/C636M Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2013.
- E. ASTM E580/E580M Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2020.
- F. ASTM E1264 Standard Classification for Acoustical Ceiling Products; 2019.
- G. NWCB TB 401 Suspension Systems for Acoustical Lay-in Ceilings, Field Technical Information; Northwest Wall and Ceiling Bureau; 2009.
- H. OSSC Oregon Structural Specialty Code, current edition.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

1.05 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate grid layout and related dimensioning and junctions with other ceiling finishes.
- C. Product Data: Provide data on suspension system components and acoustical units.
- D. Samples: Submit two samples 6 by 6 inch in size illustrating material and finish of acoustical units.
- E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 Product Requirements, for additional provisions.
 - 2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

3. Store where directed in un-opened cartons.

1.06 QUALITY ASSURANCE

- A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:
 - 1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E580.
 - CISCA's Guidelines for Systems Requiring Seismic Restraint: Comply with CISCA's "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies--Seismic Zones 3 & 4."
 - 3. ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."
 - 4. Northwest Wall and Ceiling Bureau, Technical Bulletin 401 Suspension Systems for Acoustical Lay-in Ceilings.

1.07 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 ACOUSTICAL UNITS

- A. Acoustical Panel Type ACT: Painted mineral fiber, with the following characteristics:
 - 1. Size: 24x24 inches
 - 2. Size: 24x48 inches.
 - 3. Thickness: 7/8 inches.
 - 4. Composition: Wet felted.
 - 5. Fire Resistance: Class A.
 - 6. Light Reflectance: 0.88 percent, determined as specified in ASTM E1264.
 - 7. NRC Range: 0.75 to 0.80, determined as specified in ASTM E1264.
 - 8. Ceiling Attenuation Class (CAC): 35, determined as specified in ASTM E1264.
 - 9. Edge: ACT-1 Beveled Tegular, ACT-2 Square.
 - 10. Surface Color: White.
 - 11. Surface Pattern: Non-directional fissured.
 - 12. Product: Ultima High NRC by Armstrong, Model # 1944

2.02 SUSPENSION SYSTEM(S)

- A. Manufacturers:
 - 1. Armstrong World Industries, Inc: www.armstrong.com.
 - 2. Substitutions: See Section 01 6000 Product Requirements.
- B. Metal Suspension Systems for ACT: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.
 - 1. Exposed Steel Suspension System: Formed steel, commercial quality cold rolled heavy duty main beams and intermediate duty cross runners.
 - a. Profile: Tee; 15/16 inch wide face.
 - b. Construction: Double web.
 - 2. Finish: White.
 - 3. Products:
 - a. Prelude by Armstrong.
 - b. Substitutions: See Section 01 6000 Product Requirements.

2.03 ACCESSORIES

- A. Transistions: Same metal and finish as grid.
 - 1. Profile: As shown on drawings.
 - 2. Basis of Design: Axiom Transistions by Armstrong
- B. Light Coves: Same metal and finish as grid.
 - 1. Profile: As shown on drawings.
 - 2. Basis of Design: Axiom Indirect Field Light coves by Armstrong
- C. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
 - 1. Wire gauge: Minimum 12 gauge.
- D. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.
- E. Powder-driven Anchors: When used for seismic restraint purposes, anchors to be ICC-ES approved for seismic applications.
- F. Perimeter Moldings: Same metal and finish as grid.
 - 1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.
- G. Perimeter Clips: Manufacturer's standard; approved for use in lieu of 2 inch wide perimeter molding.
- H. Seismic ceiling joint trim or device: Manufacturer's standard providing 3/4 inch movement, matching grid.
- I. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASCE 7-05, ASTM C 636/C 636M, ASTM E 580/E 580M, and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Provide seismic bracing as shown on drawings and as required by OSSC for Occupancy Category II, Seismic Design Category D. NWCB Technical Bulletin 401 may be used as a reference.
 - 1. Secure grid system to two adjacent walls, provide 3/4 inch movement at opposite walls.
 - 2. Utilize approved perimeter clips instead of 2 inch wide perimeter moldings.
 - 3. Install seismic ceiling expansion joints where indicated on drawings to divide ceiling system areas to less than 2,500 square feet.
 - 4. Install powder-driven anchors for seismic applications in accordance with ICC-ES approval and with special inspection.
- D. Locate system on room axis according to reflected plan.
- E. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 - 1. Use longest practical lengths.
- F. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.

- G. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- H. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- I. Do not allow hangers or bracing to obstruct parts of mechanical or electrical systems requiring maintenance.
- J. Provide framing around any recessed lighting fixtures and other openings.
- K. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- L. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- M. Do not eccentrically load system or induce rotation of runners.
- N. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 - 1. Use longest practical lengths.
 - 2. Overlap and rivet corners.

3.03 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install units after above-ceiling work is complete.
- E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- F. Cutting Acoustical Units:
 - 1. Cut to fit irregular grid and perimeter edge trim.
 - 2. Make field cut edges of same profile as factory edges.
 - 3. Double cut and field paint exposed reveal edges.

3.04 FIELD QUALITY CONTROL

A. An independent testing agency will perform Special Inspection for powder-driven shot-in anchors used as part of the seismic design, as specified in Section 01 1400.

3.05 CLEANING AND PROTECTION

A. Replace any damaged, chipped, scratched, or broken ceiling tile units identified up to the time of final completion. Use of sealant or putty patch material to conceal damage is not allowed.

3.06 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

SECTION 09 5426 SUSPENDED WOOD CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wood veneer panels.
- B. Linear wood planks.
- C. Metal suspension system.

1.02 RELATED REQUIREMENTS

A. Section 09 5100 - Acoustical Ceilings: Metal suspension systems.

1.03 REFERENCE STANDARDS

- A. ASTM C635/C635M Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2017.
- B. CISCA (WC) Wood Ceilings Technical Guidelines; 2009.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on wood ceiling components and suspension system components.
- C. Samples: Submit two full size samples illustrating material and finish of wood ceiling components.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See Section 01 6000 Product Requirements for additional provisions.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wood ceiling components to project site in original, unopened packages.
- B. Store in fully enclosed space, flat, level and off the floor.

1.06 FIELD CONDITIONS

- A. Do not install suspended wood ceiling system until wet construction work is complete and permanent heat and air conditioning is installed and operating.
- B. Maintain room temperature between 60 degrees F and 75 degrees F and relative humidity between 35 to 55 percent before, during, and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Suspended Wood Ceilings:
 - 1. 9Wood: www.9wood.com/#sle.
 - 2. Substitutions: See Section 01 6000 Product Requirements.

2.02 SUSPENDED WOOD CEILING SYSTEM

- A. Performance Requirements:
 - 1. Design for maximum deflection of 1/360 of span.
- B. Perforated Wood Panels Type WCT: Solid Wood core with factory finish.
 - 1. Panel Size: 24 by 48 inches.
 - 2. Wood Species: Western Hemlock.
 - a. Factory Finish: As scheduled.
 - 3. Perforations:
 - a. Shape: Circular.
 - 4. Surface Pattern: As scheduled.
 - 5. Acoustical Fabric: Manufacturer's standard black acoustrical scrim non-woven fabric.
 - 6. Attachment to Suspension Grid: Modular lift & lock, concealed grid..

- 7. Edge Profile: Square, edgeband.
- 8. Products:
 - a. 9Wood; 5200 Staggered Perforated Wood Ceiling Tiles: www.9wood.com/ceilings/#sle.
 - b. 9Wood; 9Wood; 4300 Lift & Lock Tile: www.9wood.com/ceilings/#sle.
 - c. Substitutions: See Section 01 6000 Product Requirements.
- C. Linear Wood Planks: Composite wood core with wood veneer finish.
 - 1. Type: Individual T&G linear planks.
 - a. Plank Size: 7-9/16 by 96 inches.
 - b. Plank Thickness: 3/4 inch.
 - 2. Veneer Wood Species: Cherry, Quarter Sliced.
 - a. Factory Finish: Clear sealer.
 - 3. Edge Profile: T&G
 - 4. Kerf Reveal Pattern: As specified
 - 5. Acoustical backing: same as WCT
 - 6. Attachement Style: T Bar Z Clip
 - 7. Products:
 - a. 9Wood; 3100 Acoustic Plank: www.9wood.com/ceilings/#sle.
 - b. Substitutions: See Section 01 6000 Product Requirements.
- D. Metal Suspension System:
 - 1. General: Comply with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
 - 2. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement.
- E. Accessories: Manufacturer's standard accessories for installation method indicated, seismic requirements, above-ceiling accessibility, and see Section 09 5100 for transition and cove profiles.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Do not install ceiling until after interior wet work is dry.

3.02 INSTALLATION

- A. General: Install suspended wood ceiling system in accordance with CISCA (WC).
- B. Wood Ceiling:
 - 1. Install wood ceilings in accordance with manufacturer's instructions.
 - 2. Fit wood components in place, free from damaged edges or other defects detrimental to appearance and function.
 - 3. Install components in uniform plane, and free from twist, warp, and dents.
 - 4. Cut to fit irregular grid and perimeter edge trim.
 - 5. Make field cut edges of same profile as factory edges, seal and finish according to manufacturer.

SECTION 09 6500 RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Resilient sheet flooring.
- B. Static control resilient tile flooring.
- C. Resilient base.
- D. Resilient stair accessories.
- E. Installation accessories.

1.02 RELATED REQUIREMENTS

- A. Section 01 6116 Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 03 3000 Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied resilient flooring.
- C. Section 03 5400 Cast Underlayment: Gypsum-Based Underlayment.
- D. Section 06 1000 Rough Carpentry

1.03 REFERENCE STANDARDS

- A. ASTM E648 Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2019a, with Editorial Revision (2020).
- B. ASTM F150 Standard Test Method for Electrical Resistance of Conductive and Static Dissipative Resilient Flooring; 2006 (Reapproved 2018).
- C. ASTM F970 Standard Test Method for Measuring Recovery Properties of Floor Coverings after Static Loading; 2017.
- D. ASTM F925 Resistance to Chemicals: No or slight staining
- E. ASTM F970 Residual Indentation: 1,000 PSI at or below maximum residual indentation (StandardSpecification is 175 PSI @ ≤0.005 Inch Residual Indentation).
- F. ASTM F1515 Light Stability: 300 AFU Exposure Delta E 0.38.
- G. ASTM F1861 Standard Specification for Resilient Wall Base; 2016.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions. Provide data on sealer, if recommended by flooring manufacturer.
- C. Shop Drawings: Indicate seaming plan, location of edge strips, and floor pattern as applicable.
- D. Verification Samples: Submit two samples, 6 by 12 inch in size illustrating color and pattern for each resilient flooring and base product specified.
- E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 Product Requirements, for additional provisions.
 - 2. Extra Flooring Material: 20 square feet of each type and color.
 - 3. Extra Wall Base: 10 linear feet of each type and color.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing resilient flooring with minimum three years documented experience.

B. Installer Qualifications: Compancy specializing in installing specified flooring products with minimum 5 years experience and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Deliver materials to project site in manufacturer's original, unopened containers with labels indicating brand names, colors and patterns, and quality designations legible and intact.
- C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- D. Protect roll materials from damage by storing on end and stage materials to install rolls in consecutive roll numbers.

1.07 FIELD CONDITIONS

A. Store materials for not less than 72 hours prior to installation in area of installation at a temperature of 85 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.01 SHEET FLOORING

2.02 TILE FLOORING

- A. Luxury Vinyl Tile Type LVT-1, LVT-2, & LVT-3: Printed film type, with transparent or translucent wear layer.
 - 1. Manufacturers:
 - a. Mohawk Group: www.mohawkgroup.com.
 - b. Substitutions: See Section 01 6000 Product Requirements.
 - 2. Collection: Large and Local
 - 3. Plank Tile Size: 6 by 48 inch.
 - 4. Wear Layer Thickness: 0.020 inch.
 - 5. Total Thickness: 5.5 mm
 - 6. Pattern: As indicated on drawings.
 - 7. Color: As indicated on drawings.
- B. Rubber Tile: PVC-free recycled rubber floor tile
 - 1. Manufacturers:
 - a. Roppe Corp; Rubber Tile: www.roppe.com..
 - b. Substitutions: See Section 01 6000 Product Requirements.
 - 2. Minimum Requirements: Comply with ASTM F1344, of Class corresponding to type specified.
 - 3. Size: 19 11/16 by 19 11/16 inch. Square Edge Tiles
 - 4. Total Thickness: 1/8 inch.
 - 5. Texture: Hammered.
 - 6. Color: As indicated on drawings.
- C. Rubber Sports Flooring: Type RSF .
 - 1. Manufacturers:
 - a. Roppe Corporation; Tuflex Spartus Multipurpose: www.roppe.com.
 - b. Substitutions: See Section 01 6000 Product Requirements.
 - 2. VOC Content Limits: As specified in Section 01 6116.
 - 3. Backing: Synthetic fabric.
 - 4. Thickness: 3/8 inch, minimum.
 - 5. Tile Size: 27 by 27 inches square edge.
 - 6. Surface Finish: Smooth
 - 7. Color: As indicated on drawings.
- D. Static Control Tile Type SDT: Homogeneous; color and pattern throughout thickness.

- 1. Manufacturers:
 - a. Roppe Corporation; ESD Rubber Static Control Tile: www.roppe.com/#sle.
 - b. Substitutions: See Section 01 6000 Product Requirements.
- 2. Electrical Resistance:
 - a. Conductive Tile: Resistance between 25 kiloohms and 1.0 megohms as tested in accordance with ASTM F150.
 - b. Dissipative Tile: Resistance between 1.0 megohms and 1000 megohms as tested in accordance with ASTM F150.
- 3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
- 4. Color: As indicated on drawings.

2.03 STAIR COVERING

- A. East Stair Treads: Rubber; full width and depth of stair tread in one piece; tapered thickness.
 1. Manufacturers:
 - a. Johnsonite, a Tarkett Company: www.johnsonite.com.
 - b. Roppe Corporation; Rubber Stair Treads: www.roppe.com/#sle.
 - c. Substitutions: See Section 01 6000 Product Requirements.
 - 2. Minimum Requirements: Comply with FS RR-T-650 requirements corresponding to type specified.
 - 3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
 - 4. Nominal Thickness: 0.1875 inch.
 - 5. Nosing: Square.
 - 6. Striping: 2 inch wide contrasting color abrasive strips.
 - 7. Texture: Smooth.
 - 8. Color: As scheduled.
- B. Stair Risers: Full height and width of tread in one piece, matching treads in material and color.
 - 1. Manufacturers: same as stair treads.
 - 2. Thickness: 0.080 inch.
- C. Stair Stringers: Full height in one piece and in maximum available lengths, matching treads in material and color.
 - 1. Manufacturers: same as stair treads.
 - 2. Nominal Thickness: 0.080 inch.

2.04 RESILIENT BASE

- A. Resilient Base Type B-1: ASTM F1861, Type TP, rubber, thermoplastic; top set Style B, Cove.
 - 1. Manufacturers:
 - a. Roppe Corp; 700 Series: www.roppe.com.
 - b. Burke Flooring: www.burkeflooring.com/#sle.
 - c. Johnsonite, a Tarkett Company: www.johnsonite.com.
 - d. Substitutions: See Section 01 6000 Product Requirements.
 - 2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with NFPA 253 (Class 1).
 - 3. Height: 4 inch. Provide 6 inch at first floor restrooms.
 - 4. Thickness: 0.125 inch.
 - 5. Finish: Satin.
 - 6. Length: Roll.
 - 7. Color: As shown on drawings.
 - 8. Provide sealant at base in first floor restrooms.

2.05 ACCESSORIES

A. Moisture Barrier & Primer: Use TEK Max[™] over properly prepared gypsum-based underlayment.

- 1. The slab sealer material must be compatible with previously applied curing agents, and adhesives and must meet the CRI low-VOC emission criteria, C.R.I. ID# AA-580309, and shall not contain any known hazardous materials. The material must be non-toxic, ultra-low odor, waterproof when dry.
 - a. One Coat: 95.0% RH and/or 12 lbs. MVER
 - b. Two Coats: 99.0% RH and/or 18 lbs. MVER
- 2. Extent of Work: Provide floor sealer on all gypsum-based underlayment to receive new floor covering.
- B. Patching, Leveling, Underlayment: Use over top of TEK Max[™] when moisture levels exceed adhesive limits.
 - 1. Trowalable or Self-Leveling Portland cement and/or calcium aluminate patching and leveling compound.
 - 2. Recommended by its manufacturer for intended use conditions.
 - 3. The underlayment shall be mold, mildew and alkali resistant, non-shrinking and water-resistant with a mininum 3,500 psi cured compressive strength.
- C. Adhesives: As recommended by flooring manufacturer to suit material and substrate conditions.
 - 1. VOC Content Limits: As specified in Section 01 6116.
- D. Gypsum patching compounds shall not be used unless recommended and warranted by product manufacturer as project compliant.
- E. Moldings, Transition and Edge Strips: Glue-down vinyl, Johnsonite "slim line" series, or approved; style appropriate for thicknesses of materials used.
- F. Copper Grounding Strips: Type and size as recommended by static control flooring manufacturer.
- G. Rubber Base Sealant: Clear silicone sealant.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, 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. Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
- C. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.
- C. Prohibit traffic until filler is fully cured.
- D. The subfloor surface shall be smooth and flat to 3/16" in 10 ft. (3.9 mm in 3 m) and 1/32" in 1 ft. (1 mm in 300 cm) per ASTM F710.
- E. Where leveling or smoothing is required, apply trowelable or self-leveling Portland cement and or calcium aluminate patching and leveling compound recommended by its manufacturer for intended use conditions. Apply compound in accordance with manufacturer's current printed instructions. The underlayment shall be mold, mildew and alkali resistant, non-shrinking and water-resistant with a minimum 3,500 psi cured compressive strength. Ensure proper mix water ratio, working time and drying time.
- F. Porous and/or dusty structurally sound substrates shall be primed by applying one or more coats of TEK Max[™] with a short nap paint roller and allowed to dry before proceeding.

3.03 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Spread only enough adhesive to permit installation of materials before initial set.
- D. Fit joints and butt seams tightly.
- E. Set flooring in place, press with heavy roller to attain full adhesion.
- F. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- G. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
- H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.04 INSTALLATION - TILE FLOORING

- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.
- B. Install tile flooring in pattern as indicated on the drawings.
- C. Rubber Static Control Tile;
 - 1. Attach one copper ground connection per 1,000 square feet.
 - 2. Layout resilient flooring to provide equal size at perimeter. Adjust layout as necessary to eliminate resilient flooring which is cut to less than half width.
 - 3. Lay resilient flooring with arrows in same direction.
 - 4. Install resilient flooring without cracks or voids at seams. Lay seams together without stress. Remove excess adhesive immediately.
 - 5. Install reducer strips at exposed edges.

3.05 INSTALLATION - RESILIENT BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold.
- C. Install base on solid backing. Bond tightly to wall and floor surfaces.
- D. Scribe and fit to door frames and other interruptions.
- E. At all areas where rubber base is scheduled provide silicone sealant under base at top and bottom edges and at all joints and corners. This applies to all janitor closets and other potentially wet areas.

3.06 INSTALLATION - STAIR COVERINGS

- A. Install stringers configured tightly to stair profile.
- B. Adhere over entire surface. Fit accurately and securely.

3.07 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

3.08 PROTECTION

A. Prohibit traffic on resilient flooring for 24 hours and protect flooring from rolling and heavy point loads for 48-72 hours.

SECTION 09 6813 TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Carpet tile.
- B. Entry Mat.

1.02 RELATED REQUIREMENTS

- A. Section 01 6116 Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 03 3000 Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied flooring.
- C. Section 03 5400 Cast Underlayment

1.03 REFERENCE STANDARDS

- A. ASTM D2859 Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2016.
- B. ASTM E648 Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2019a, with Editorial Revision (2020).
- C. CRI 104 Standard for Installation of Commercial Carpet; 2015.
- D. CRI (GLP) Green Label Plus Testing Program Certified Products; Current Edition.
- E. NFPA 253 Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2019.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate layout of joints, direction of carpet pile, and location of edge moldings.
- C. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- D. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
- E. Submit two, 12 inch long samples of edge strip.
- F. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- G. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
- H. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 Product Requirements, for additional provisions.
 - 2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.

1.06 FIELD CONDITIONS

A. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Carpet Tile Type CPT-1: Tufted.
 - 1. Basis of Design Product: Data Tide, River Code manufactured by Mohawk Group.
 - 2. Tile Size: 12 x 36 inch, nominal.
 - 3. Colors & Installation Method: As indicated on drawings.
 - 4. VOC Content: Comply with Section 01 6116.
 - 5. Stitches: 11.3 per inch.
 - 6. Yarn Type: 100% Recycled Content Nylon
 - 7. Traffic Classification: Heavy
 - 8. Backing Material: EcoFlex NXT.
- B. Carpet Tile Type CPT-2: Tufted
 - 1. Basis of Design Product: Data Tide, Aqua Rhythm manufactured by Mohawk Group.
 - 2. Tile Size: 12 x 36 inch, nominal.
 - 3. Color: As Indicated on the drawings.
 - 4. VOC Content: Comply with Section 01 6116.
 - 5. Stitches: 11.9 per inch.
 - 6. Dye Method: 100% solution dyed.
 - 7. Primary Backing Material: EcoFlex NXT.
- C. Walk-Off Mat (WALK)
 - 1. Basis-of-Design.
 - a. Product:
 - 1) Tarkett; Product Assertive Stria: www.tarkettna.com.
 - 2. VOC Content: Provide CRI Green Label Plus certified product; in lieu of labeling, independent test report showing compliance is acceptable.
 - 3. Color: As indicated on drawings.
 - 4. Gauge: 5/64 inch.
 - 5. Size: 6 foot roll
 - 6. Backing Material: Synthetic Non-Woven.
 - 7. Total Weight: 28 oz/sq yd. As standard with the manufacturer.
- D. CONCRETE SLAB MOISTURE BARRIER:
 - 1. High strength, latex-based compound formulated to isolate cut-back and existing adhesives that could affect the bond of the new floor adhesives.
 - 2. The slab sealer material must be compatible with previously applied curing agents, and adhesives and must meet the CRI low-VOC emission criteria, C.R.I. ID# AA-580309, and shall not contain any known hazardous materials. The material must be non-toxic, ultra-low odor, waterproof when dry.
 - 3. Flammability Certification: Class A: Passes tunnel test ASTM number E84-70 (identical test method to ANS Number 2-5), NFPA number 755, UL number 723, and UBC 42-1.
 - 4. Warranty: Provide manufacturers lifetime moisture vapor emissions and moisture penetration warranty. Follow manufacturer's installation instructions exactly to guarantee that warranty will be issued.
 - 5. Products:
 - a. J & J Commercialon: 877 Premium Barrier Coat
 - b. Substitutions: See Section 01 6000 Product Requirements.

2.02 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.
- B. Edge Strips: Glue-down vinyl or rubber. Johnsonite "slim line" series, or approved equal; style appropriate for thicknesses of materials used, color as scheduled.
- C. Entry Mat Tile Adhesive: Recommended by carpet tile manufacturer.

D. Glue-Free Carpet Tile Adhesive - Similar to Interface TacTiles and Kinetex Prefix at all locations except at Entry Mat.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
- B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.
- C. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
 - 1. Test in accordance with ASTM F710.
 - 2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

3.02 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.
- C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
- D. Vacuum clean substrate.
- E. Wet mop immediately prior to new carpet tile installation, and remove all deleterious substances which would interfere with the installation, would be harmful to the work, or would inhibit the free-lay method of installation of carpet tiles.

3.03 INSTALLATION

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install carpet tile in accordance with manufacturer's instructions.
- C. Blend carpet from different cartons to ensure minimal variation in color match.
- D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- E. Lay carpet tiles as indicated on the finish drawings.
- F. Locate change of color or pattern between rooms under door centerline for dissimilar materials. For areas of carpet tile at adjacent rooms, continue pattern through room as shown on the finish drawings.
- G. Roll the entire carpet installation with a 75 pound or greater roller to assure proper adhesion to the substrate if required in manufacturer's installation instructions.
- H. Adhere carpet tiles to each other with glue-free adhesive squares in accordance with instructions, to create a "floating floor" for CPT-1, and CPT-3. Apply squares at every corner.
- I. Trim carpet tile neatly at walls and around interruptions.
- J. Complete installation of edge strips, concealing exposed edges.

3.04 ENTRY MAT INSTALLATION

- A. Install in strict accordance with manufacturer's recommendations, using manufacturer's recommended adhesive suitable for project conditions.
- B. Follow manufacturer's recommended seaming techniques.
- C. Roll with appropriate roller for complete contact of adhesive to entry mat backing, rolling at least twice, once in each direction.
- D. Keep all traffic off entry mat for 24 hours after installation. Wait 72 hours prior to initial cleaning.

E. Lay entry mat in pattern as directed by manufacturer.

3.05 CLEANING

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.

SECTION 09 7200 WALL COVERINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Wall covering.

1.02 RELATED REQUIREMENTS

- A. Section 01 6116 Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 09 2116 Gypsum Board Assemblies.

1.03 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on wall covering and adhesive.
- C. Shop Drawings: Indicate wall elevations with seaming layout.
- D. Samples: Submit two samples of wall covering, 11 by 17 inch in size illustrating color, finish, and texture.
- E. Manufacturer's Installation Instructions: Indicate special procedures.
- F. Maintenance Data: Submit data on cleaning, touch-up, and repair of covered surfaces.
- G. Manufacturer's Qualification Statement.
- H. Installer's Qualification Statement.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Inspect roll materials at arrival on site, to verify acceptability.
- B. Protect packaged adhesive from temperature cycling and cold temperatures.
- C. Do not store roll goods on end.

1.07 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the adhesive or wall covering product manufacturer.
- B. Maintain these conditions 24 hours before, during, and after installation of adhesive and wall covering.

PART 2 PRODUCTS

2.01 WALL COVERINGS

- A. General Requirements:
 - 1. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.
- B. Wall Covering: Fabric-backed vinyl roll stock.
 - 1. Total Weight: 20 oz/sq yd.
 - 2. Face: Latex-Saturated Wet Strength Paper.

- 3. Backing: Textile Scrim Backed PVC-free.
 - a. Type II White Vinyl.
- 4. Inks: UV-LED inks with low or no-VOCs.
- 5. Coating: Heavy metal free UV cured matte coating with fire retardancy, anti-microbial, mold and mildew resistance properties.
- 6. Surface Texture: smooth.
- 7. Image: Photographic image to be provided by Architect.
- 8. Manufacturers:
 - a. Gravity Digital Walls: www.gravitydigitalwalls.com
 - b. Tectonics: www.tectonics.com
 - c. Substitutions: See Section 01 6000 Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are prime painted and ready to receive work, and comply with requirements of wall covering manufacturer.
- B. Measure moisture content of surfaces using an electronic moisture meter. Do not apply wall coverings if moisture content of substrate exceeds level recommended by wall covering manufacturer.

3.02 PREPARATION

- A. Wash impervious surfaces with tetra-sodium phosphate, rinse and neutralize; wipe dry.
- B. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- C. Surfaces: Correct defects and clean surfaces that affect work of this section.
- D. Vacuum clean surfaces free of loose particles.

3.03 INSTALLATION

- A. Apply adhesive and wall covering in accordance with manufacturer's instructions.
- B. Apply adhesive to wall covering surface immediately prior to application of wall covering.
- C. Apply wall covering smooth, without wrinkles, gaps or overlaps. Eliminate air pockets and ensure full bond to substrate surface.
- D. Butt edges tightly.
- E. Align edges of pattern in accordance with manufacturer's instructions and approved shop drawings.
- F. Trim in accorance with manufacturer's instructions.
- G. Use only lead pencil for marking walls and back of wallcovering. Do not use ballpoint or marking pen, they will bleed through surface.
- H. Remove excess adhesive while wet from seam before proceeding to next wall covering sheet. Wipe clean with dry cloth.

3.04 CLEANING

- A. Clean wall coverings of excess adhesive, dust, dirt, and other contaminants.
- B. Reinstall wall plates and accessories removed prior to work of this section.

3.05 PROTECTION

A. Do not permit construction activities at or near finished wall covering areas.

SECTION 09 8430 SOUND-ABSORBING WALL AND CEILING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sound-absorbing panels.
- B. Mounting accessories.

1.02 RELATED REQUIREMENTS

A. Section 09 2116 - Gypsum Board Assemblies

1.03 REFERENCE STANDARDS

- A. ASTM C423 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2017.
- B. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's printed data sheets for products specified.
- C. Shop Drawings: Fabrication and installation details, panel layout, fabric orientation, and wood grain orientation.
- D. Verification Samples: Fabricated samples of each type of panel specified; 6 inch, showing construction, edge details, and fabric covering.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect acoustical units from moisture during shipment, storage, and handling. Deliver in factory-wrapped bundles; do not open bundles until units are needed for installation.
- B. Store units flat, in dry, well-ventilated space; do not stand on end.
- C. Protect edges from damage.

PART 2 PRODUCTS

2.01 PLASTIC SOUND-ABSORBING UNITS

- A. Manufacturers:
 - 1. Acoufelt; www.acoufelt.com.
 - 2. Substitutions: See Section 01 6000 Product Requirements.
- B. Thermoformed Copolymer Plastic Acoustical Panels for Walls:
 - 1. AWP-1, AWP-2, AWP-3: basis of design is Acoufelt Swell Wall Tile
 - a. Thickness: .47" (12 MM)
 - b. Color: As specified on drawings
 - c. Size: 12" x 12"
 - d. Installation Layout: As specified on drawings
 - e. Mounting: Back mounted with manufacturer's standard adhesive, secured to substrate
 - 2. AWP-4: basis of design is Acoufelt Solid Panel
 - a. Thickness: .47" (12 MM)
 - b. Color: As specified on drawings
 - c. Size: 48" x 110"
 - d. Installation Layout: As specified on drawings

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e. Mounting: Back mounted with manufacturer's standard adhesive, secured to substrate

2.02 ACCESSORIES

A. Fixing Clips: Manufacturers standard for application as indicated.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install acoustical units in locations as indicated, following manufacturer's installation instructions.
- B. Install mounting accessories and supports in accordance with shop drawings.
- C. Align panels accurately, with edges plumb and top edges level. Scribe to fit accurately at adjoining work and penetrations.
- D. Install acoustical units to construction tolerances of plus or minus 1/16 inch for the following:
 - 1. Plumb and level.
 - 2. Flatness.

3.02 CLEANING

A. Clean sound-absorptive panels upon completion of installation from dust and other foreign materials, following manufacturer's instructions.

3.03 PROTECTION

- A. Provide protection of installed acoustical panels until Date of Substantial Completion.
- B. Replace panels that cannot be cleaned and repaired to satisfaction of the Architect.

SECTION 09 9000 PAINTING AND COATING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints, stains, varnishes, and other coatings.
- C. Materials for backpriming woodwork.
- D. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
 - 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
 - 2. Mechanical and Electrical:
 - a. In finished areas, paint all insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
 - b. In finished areas, paint shop-primed items.
 - c. Paint interior surfaces of air ducts and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
- E. Do Not Paint or Finish the Following Items:
 - 1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
 - 5. Non-metallic roofing and flashing.
 - 6. Stainless steel, anodized aluminum, bronze, terne, and lead items, unless otherwise indicated.
 - 7. Marble, granite, slate, and other natural stones.
 - 8. Floors, unless specifically so indicated.
 - 9. Ceramic and other tiles.
 - 10. Brick, architectural concrete, cast stone, integrally colored plaster and stucco.
 - 11. Exterior insulation and finish system (EIFS).
 - 12. Glass.
 - 13. Acoustical materials, unless specifically so indicated.
 - 14. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

- A. Section 01 6116 Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 05 5000 Metal Fabrications: Shop-primed items.
- C. Section 05 5100 Metal Stairs: Shop-primed items.

1.03 REFERENCE STANDARDS

- A. ASTM D16 Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2016.
- B. ASTM D4442 Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2016.
- C. MPI (APL) Master Painters Institute Approved Products List; Master Painters and Decorators Association; current edition, www.paintinfo.com.

- D. MPI (APSM) Master Painters Institute Architectural Painting Specification Manual; Current Edition, www.paintinfo.com.
- E. SSPC-SP 1 Solvent Cleaning; 2015, with Editorial Revision (2016).
- F. SSPC-SP 2 Hand Tool Cleaning; 2018.
- G. SSPC-SP 6 Commercial Blast Cleaning; 2007

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide complete list of all products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
 - 4. Manufacturer's installation instructions.
- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
 - 1. Where sheen is specified, submit samples in only that sheen.
- D. Stain Samples: Provide manufacturer's standard color samples to assist Architect in determining the final color.
 - 1. Architect will select up to three colors to be applied to the specified wood siding for final color selection.
- E. Certification: By manufacturer that all paints and coatings comply with VOC limits specified.
- F. Manufacturer's Instructions: Indicate special surface preparation procedures.
- G. Maintenance Data: Submit data including product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, and repair of painted and coated surfaces.
- H. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 Product Requirements, for additional provisions.
 - 2. Extra Paint and Coatings: 1 gallon of each color; store where directed.
 - 3. Label each container with color in addition to the manufacturer's label.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five years experience.

1.06 MOCK-UP

- A. See Section 01 4000 Quality Requirements, for general requirements for mock-up.
- B. Provide panel, 10 feet long by 10 feet wide, illustrating paint coating cut-in, color, texture, and finish.
- C. Provide door and frame assembly illustrating paint coating cut-in, color, texture, and finish.
- D. Locate where directed.
- E. Mock-up may remain as part of the work.

1.07 INTERIOR COLOR STUDY

- A. Assist the Architect in the final interior color selection by painting the approved paint material in 4 feet wide x 4 feet tall test patches on selected interior finished wall surfaces where directed by Architect on walls to receive accent colors.
- B. Provide one test patch of each interior paint color included in the color schedule.
- C. Provide up to two additional color test patches of up to 6 of the scheduled interior colors showing adjusted color values as directed by Architect.
- D. After final color selection, cover over the test samples with primer to eliminate color bleedthrough and recoat with final approved colors.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.
- D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction over project.

1.09 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide all paint and coating products used in any individual system from the same manufacturer; no exceptions.
- B. Provide all paint and coating products from the same manufacturer to the greatest extent possible.
 - 1. In the event that a single manufacturer cannot provide all specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
 - 2. Substitution of MPI-approved products by a different manufacturer is preferred over substitution of unapproved products by the same manufacturer.
- C. Paints:
 - 1. Glidden Professional, a product of PPG Architectural Coatings: www.gliddenprofessional.com.
 - 2. Benjamin Moore & Co: www.benjaminmoore.com/#sle.
 - 3. Parker Paint Mfg Co Inc., a Comex Group company: www.parkerpaint.com.
 - 4. PPG Paints: www.ppgpaints.com/#sle.
 - 5. Pratt & Lambert Paints: www.prattandlambert.com/#sle.
 - 6. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
- D. Primer Sealers: Same manufacturer as top coats.
- E. Block Fillers: Same manufacturer as top coats.
- F. Substitutions: See Section 01 6000 Product Requirements.

2.02 PAINTS AND COATINGS - GENERAL

- A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
 - 1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.
 - 2. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 3. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
 - 4. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
 - 5. Supply each coating material in quantity required to complete entire project's work from a single production run.
 - 6. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.
- B. Primers: As follows unless other primer is required or recommended by manufacturer of top coats; where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.
- C. Volatile Organic Compound (VOC) Content: Comply with Section 01 6116.
- D. Chemical Content: The following compounds are prohibited:
 - 1. Aromatic Compounds: In excess of 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
 - 2. Acrolein, acrylonitrile, antimony, benzene, butyl benzyl phthalate, cadmium, di (2-ethylhexyl) phthalate, di-n-butyl phthalate, di-n-octyl phthalate, 1,2-dichlorobenzene, diethyl phthalate, dimethyl phthalate, ethylbenzene, formaldehyde, hexavalent chromium, isophorone, lead, mercury, methyl ethyl ketone, methyl isobutyl ketone, methylene chloride, naphthalene, toluene (methylbenzene), 1,1,1-trichloroethane, vinyl chloride.
- E. Flammability: Comply with applicable code for surface burning characteristics.
- F. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- G. Colors: As indicated in Color Schedule
 - 1. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.
 - 2. In utility areas, finish equipment, piping, conduit, and exposed duct work in colors according to the color coding scheme indicated.

2.03 REFERENCED GLOSS LEVELS

- A. Some of the following Gloss Level references may be used in the Paint Systems outlined below and are defined here for reference. Gloss units are as measured at 60 degrees from perpendicular, per ASTM D523.
 - 1. Gloss Level 1 a traditional matte finish flat: maximum 5 units.
 - 2. Gloss Level 2 a high side sheen flat a 'velvet-like' finish: maximum 10 units.
 - 3. Gloss Level 3 a traditional 'eggshell-like' finish: 10-25 units.
 - 4. Gloss Level 4 a 'satin: 20-35 units.
 - 5. Gloss Level 5 a traditional semi-gloss: 35-70 units.
 - 6. Gloss Level 6 a traditional gloss: 70-85 units.
 - 7. Gloss Level 7 a high gloss: more than 85 units.

2.04 PAINT SYSTEMS - EXTERIOR

- A. Ferrous Metals (including steel concealed in building canopies), Unprimed, 3 Coat:
 - 1. One coat of alkyd primer MPI #79.

- 2. Semi-gloss: Two coats of latex enamel MPI #163.
- B. Galvanized Metals, High-Performance Coating (including exterior stairs):
 - 1. One coat epoxy primer MPI #108
 - 2. Semi-gloss: Two coats Aliphatic Urethane MPI #72
- C. D. Wood Siding:
 - 1. One coat Minwax oil-based, penetrating exterior transparent wood stain a. Color: to be selected from manufacturer's standard colors
 - 2. Two coats Minwax Helmsman Spar Urethane, satin finish, MPI #194
 - 3. Substitutions: See Section 01 6000 Product Requirements: Two coats Aliphatic Urethane MPI #72

2.05 PAINT SYSTEMS - INTERIOR

- A. Wood, Transparent, Low-VOC Polyurethane Varnish:
 - 1. One coat sealer recommended by varnish manufacturer.
 - 2. Satin: Two coats of varnish, MPI #128.
- B. Ferrous Metals to be painted, Primed and Unprimed, Low-VOC Latex:
 - 1. If unprimed: One coat of rust-inhibitive primer, MPI #107.
 - 2. Semi-gloss: Two coats of latex enamel, MPI #147.
- C. Gypsum Board/Plaster, Wet Areas (restrooms, showers, kitchens, janitor's rooms, and where noted):
 - 1. One coat of PVA epoxy primer sealer, MPI #50.
 - 2. Semi-gloss: Two coats of epoxy enamel, MPI #215.
- D. Gypsum Board/Plaster, all other areas:
 - 1. One coat of PVA primer sealer, MPI #50.
 - 2. Eggshell (Satin): Two coats of latex enamel, MPI #146.
- E. Wood, Opaque, Alkyd, 2 Coat:
 - 1. One coat of alkyd primer sealer.
 - 2. Eggshell: One coat of alkyd enamel

2.06 ACCESSORY MATERIALS

- A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- D. Test shop-applied primer for compatibility with subsequent cover materials.
- E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Gypsum Wallboard: 12 percent.
 - 2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
 - 3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
 - 4. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to coating application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

3.03 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's instructions.
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance.
- E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

- A. Protect finished coatings until completion of project.
- B. Touch-up damaged coatings after Substantial Completion.

SECTION 09 9623 ANTI-GRAFFITI COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Integral Anti-Graffiti and Water Repellent coatings.
- B. Special preparation of surfaces

1.02 RELATED SECTIONS

- A. Section 03 3000 Cast-in-Place Concrete
- B. Section 03 4100 Precast Structural Concrete
- C. Section 04 20 00 Unit Masonry: Cleaning of masonry.
- D. Section 07 90 05 Joint Sealers

1.03 PERFORMANCE REQUIREMENTS

- A. Provide coating systems that meet the following minimum performance criteria, unless more stringent criteria are specified
 - 1. Scrubbability: Excellent, when tested in accordance with manufacturer's instructions.

1.04 SUBMITTALS

- A. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements, including compatibility with Water Repellent specified under 07 1900.
- C. Maintenance Data: Include cleaning procedures and repair and patching techniques.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than ten years of experience.
- B. Applicator Qualifications: Company specializing in performing the work of this section with minimum five years of experience.

1.06 ADVANCE NOTICE

A. Notify Architect at least 48 hours prior to completing the work of this section.

1.07 MOCK-UP

- A. Provide test panel 10 feet long by 4 feet wide, illustrating complete application and coverage for each substrate.
- B. Locate where directed and under observation of manufacturer's representative.
- C. Verify that Anti-Graffiti Protection System will effectively repel paint and other markings from Surface, and will produce no surface stains when cleaned.
- D. Mock-up may remain as part of the Work.

1.08 PRE-INSTALLATION MEETING

A. Convene one week before starting work of this section.

1.09 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

- D. Store products of this section in manufacturer's unopened packaging until installation.
- E. Establish and maintain storage area conditions for products of this section in accordance with manufacturer's instructions until installation.
- F. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction over project.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Do not install materials when temperature is below 55 degrees F or above 90 degrees F.
- B. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.
- C. Restrict traffic from area where coating is being applied or is curing.
- D. The surfaces should be visibly dry, and ambient conditions, including relative humidity, should be such that condensation does not form on the surface during application.
- E. In hot weather, avoid applying the coatings in the direct sunlight during the hottest parts of the day.
- F. In cold weather, apply the coating later in the day when the surface temperature is higher.
- G. Perform no work when weather exceeds Manufacturer's specified limits.

1.11 EXTRA MATERIALS

- A. See Section 01600 Product Requirements, for additional provisions.
- B. Supply two gallons for Owner's use in maintenance of project.
- C. Supply two containers of paint removal products for Owner's use in maintaining anti-graffiti coating.
- D. Store where directed by Architect.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Prosoco "Bloc-Guard & Graffiti Control", water and graffiti repellent.
- B. Evonik Industries; Protectosil water repellent and Anti graffiti .
- C. Substitutions: See Section 01600 Product Requirements.

2.02 MATERIALS

- A. Non-gloss, non-yellowing, clear and colorless, hydrophobic coating.
- B. Provide complete system formulated and recommended by manufacturer for the applications indicated, in the coverage rates as determined by substrate specific conditions.
 - 1. Maximum volatile organic compound (VOC) content: As required by applicable regulations.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that substrate surfaces are ready to receive work as instructed by the coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.
- C. Verify that the anti-graffiti coating is compatible with dampproofing and other sealers previously applied or to be applied to the wall surfaces.

3.02 PREPARATION

A. Clean surfaces of loose foreign matter, pressure wash if necessary. Remove all foreign materials which would inhibit penetration and adhesion of the product.

B. Protect adjacent surfaces and materials not receiving coating from overspray; mask if necessary to provide adequate protection. Repair damage.

3.03 COATING APPLICATION

- A. Apply coatings in accordance with manufacturer's instructions, to coverage rate determined by test panel.
- B. Apply in uniform thickness coats, without variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.
- C. Apply Coatings without adulteration.
- D. Take precautions to avoid harm to building occupants and others on site from fumes. Cover any air intakes and other building openings that may come in contact with the product or fumes from the application. Keep coverings in place until odors have dissipated.
- E. Applicators shall wear appropriate Safety Equipment when working with or installing this material. Follow Manufacturer's recommendations.
- F. Start application at surface top and work downward. Apply at rate sufficient to thoroughly wet surface in accordance with Manufacturer's Instructions.

3.04 CLEANING

- A. Immediately after application, remove any overspray on adjacent Materials.
- B. Collect waste material which may constitute a fire hazard, place in closed metal containers, and remove daily from site.
- C. Clean surfaces immediately of overspray, splatter, and excess material

3.05 SCHEDULES

- A. Apply to all Concrete Masonry Unit Veneer.
- B. Apply to all vertical surfaces of pre-cast and cast-in-place concrete on the parking garage.

SECTION 10 1100 VISUAL DISPLAY UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tackboards.
- B. Markerboards

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Blocking and supports.

1.03 REFERENCE STANDARDS

A. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2018.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's data on markerboard, tackboard, tackboard surface covering, and accessories.
- C. Shop Drawings: Indicate wall elevations, dimensions, joint locations, special anchor details.
- D. Samples: Submit two samples 2 by 2 inch in size illustrating materials and finish, color and texture of markerboard, tackboard, tackboard surfacing, and trim.
- E. Manufacturer's printed installation instructions.
- F. Maintenance Data: Include data on regular cleaning, stain removal.

1.05 QUALITY ASSURANCE

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

1.06 WARRANTY

- A. See Section 01 7800 Closeout Submittals, for additional warranty requirements.
- B. Provide five year warranty for markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Markerboards:
 - 1. Claridge Products and Equipment, Inc: www.claridgeproducts.com.
 - 2. Substitutions: See Section 01 6000 Product Requirements.

2.02 MARKERBOARDS

- A. Surface Attached Magnetic Markerboards: Porcelain enamel on steel, laminated to core.
 - 1. Product: Basis of Design Claridge Series 2000 Markerboard
 - 2. Color: Similar to Claridge #75 LCS-II low-gloss.
 - 3. Metal Steel Face Sheet Thickness: 24 gage, 0.0239 inch.
 - 4. Core: Medium density fiberboard, 7/16 inch thick, laminated to face sheet.
 - 5. Backing: Aluminum foil, laminated to core.
 - 6. Size: As noted on drawings.
 - 7. Frame: Narrow face satin anodized aluminum trim.

2.03 TACKABLE WALL PANELS

- A. Surface attached tackboards: cork, laminated to backing..
 - 1. Product Basis of Design: Claridge Series 2000 Tackboard.
 - 2. Surface Material: similar to Claridge Cork, 1/4" thick, self-healing, burlap-backed.
 - 3. Surface Color: similar to Claridge Cork No. 1111 Smoke

- 4. Backing: 1/4" hardboard.
- 5. Size: As indicated on drawings.
- 6. Frame: factory-built trim. 6063 alloy grade aluminum with T5 tempering in accordance with ASTM B221, and shall have 201-R1 satin anodize finish.

2.04 MATERIALS

- A. Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.
- B. MDF for Core: Medium-density fiberboard fabricated with no added urea-formaldehyde.
- C. Foil Backing: Aluminum foil sheet, 0.005 inch thick.
- D. Adhesives: Low VOC or water-based, approved by panel manufacturer, and complying with requirements of Section 01 6116.

2.05 ACCESSORIES

- A. Temporary Protective Cover: Sheet polyethylene, 8 mil thick.
- B. Marker Tray: Aluminum, manufacturer's standard profile, one piece full length of markerboard, molded ends, concealed fasteners, same finish as frame.
- C. Mounting Brackets: Concealed, Z-clips.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.
- C. Verify flat wall surface for frameless adhesive-applied boards.

3.02 INSTALLATION

- A. Install boards in accordance with manufacturer's instructions for mechanical installation.
- B. Secure units level and plumb.
- C. Butt Joints: Install with tight hairline joints.
- D. Carefully cut holes in boards for thermostats, wall switches, and other devices.

3.03 CLEANING

- A. Clean board surfaces in accordance with manufacturer's instructions.
- B. Cover with protective cover, taped to frame.
- C. Remove temporary protective cover at Date of Substantial Completion.

SECTION 10 2113.19 PLASTIC TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Solid plastic toilet compartments.
- B. Urinal screens.

1.02 RELATED REQUIREMENTS

- A. Section 06 1000 Rough Carpentry: Blocking and supports.
- B. Section 10 2800 Toilet, Bath, and Laundry Accessories.

1.03 REFERENCE STANDARDS

- A. ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- B. NFPA 286 Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.05 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on panel construction, hardware, and accessories.
- C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
- D. Samples: Submit two samples of partition panels, 6 by 6 inch in size illustrating panel finish, color, and sheen.
- E. Manufacturer's Installation Instructions: Indicate special procedures.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Solid Color Reinforced Composite Substrate Toilet Compartments:
 - 1. Scranton Products; Eclipse Partitions: www.scrantonproducts.com/#sle.
 - 2. Bobrick Washroom Equipment, Inc: www.bobrick.com. Basis of Design: Sierra Series by Bobrick.
 - 3. Substitutions: Section 01 6000 Product Requirements.

2.02 PLASTIC TOILET COMPARTMENTS

- A. Solid Plastic Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid molded high density polyethylene (HDPE), tested in accordance with NFPA 286; floor-mounted headrail-braced.
- B. Doors:
 - 1. Thickness: 1 inch.
 - 2. Width: 24 inch.
 - 3. Width for Accessible Use: 36 inch.
 - 4. Height: 62 inch.
- C. Panels:
 - 1. Thickness: 1 inch.
 - 2. Height: 62 inch.
- D. Pilasters:
 - 1. Thickness: 1-1/2 inch.

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PLASTIC TOILET COMPARTMENTS

- 2. Width: As required to fit space; minimum 3 inch.
- E. Screens: Without doors; to match compartments; mounted to wall with double ear panel brackets.

2.03 ACCESSORIES

- A. Pilaster Shoes: Formed ASTM A666, Type 304 stainless steel with No. 4 finish, 4 inch high, concealing floor fastenings.
 - 1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.
- B. Head Rails: Extruded aluminum, anti-grip profile.
 - 1. Size: Manufacturer's standard size.
- C. Wall and Pilaster Brackets: Stainless steel; manufacturer's standard type for conditions indicated on drawings.
- D. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
- E. Hardware:
 - 1. Compliance: Operating force of less than 5 lb (2.25 kg).
 - 2. Emergency Access: Hinges, door latch allow door to be lifted over keeper from outside compartment on inswing doors.
 - 3. Materials: 18-8, Type 304, heavy-gauge stainless steel with satin finish.
 - 4. Doorstops: Prevents inswinging doors from swinging out beyond stile; on outswing doors, doorstop prevents door from swinging in beyond stile.
 - 5. Fastening: Hardware secured to door and stile by through-bolted, theft-resistant, pin-in-head Torx stainless steel machine screws into factory-installed, threaded brass inserts. Fasteners secured directly into core not acceptable.
 - a. Threaded Brass Inserts: Factory-installed; withstand direct pull force exceeding 1500 lb per insert.
 - 6. Clothes Hooks: Projecting no more than 1-1/8 inch from face of door.
 - 7. Door Latch: Track of door latch prevents inswing doors from swinging out beyond stile; on outswing doors, door keeper prevents door from swinging in beyond stile; 16 gauge sliding door latch, 14 gauge keeper.
 - 8. Locking: Door locked from inside by sliding door latch into keeper.
 - 9. Hinge Type:
 - a. Full-Height Institutional Hinge.
 - 1) Hinges: 16 gauge stainless steel, self-closing, 3 section hinges.
 - 10. Mounting Brackets:
 - a. Full-Height.
 - 1) Mounting Brackets: 18 gauge stainless steel and extend full height of panel.
 - 2) U-Channels: Secure panels to stiles.
 - 3) Angle Brackets: Secure stiles-to-walls and panels to walls.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify correct spacing of and between plumbing fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 PREPARATION

- A. Prepare substrates including but not limited to blocking and supports in walls and ceilings at points of attachment using methods recommended by the manufacturer for achieving the best result for the substrates under the project conditions.
 - 1. Inspect areas scheduled to receive compartments for correct dimensions, plumbness of walls, and soundness of surfaces that would affect installation of mounting brackets.

- 2. Verify spacing of plumbing fixtures to assure compatibility with installation of compartments.
- B. If preparation is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.
- C. Do not proceed with installation until substrates have been properly prepared with blocking and supports in walls and ceilings at points of attachment and deviations from manufacturer's recommended tolerances are corrected. Commencement of installation constitutes acceptance of conditions.

3.03 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 inch to 1/2 inch space between wall and panels and between wall and end pilasters.
- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.
- E. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.04 TOLERANCES

- A. Maximum Variation From True Position: 1/4 inch.
- B. Maximum Variation From Plumb: 1/8 inch.

3.05 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
- B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
- C. Adjust adjacent components for consistency of line or plane.
- D. Touch-up, repair or replace damaged products.
- E. Clean exposed surfaces of compartments, hardware, and fittings.

SECTION 10 2600 WALL AND DOOR PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Corner guards.

1.02 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements for submittal procedures.
- B. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, anchorage details, and rough-in measurements.
- C. Shop Drawings: Include plans, elevation, sections, and attachment details. Show design and spacing of supports for protective corridor handrails, required to withstand structural loads.
- D. Samples: Submit samples illustrating component design, configurations, joinery, color and finish.
- E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.
- B. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

1.04 WARRANTY

- A. See Section 01 7800 Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 5-year manufacturer warranty for metal crash rails. Complete forms in Owner's name and register with manufacturer.
- C. Installer Warranty: Provide 5-year warranty for metal crash rails commencing on Date of Substantial Completion. Complete forms in Owner's name and register with installer.
 - 1. Failures include, but are not limited to, the following:
 - a. Detachment of rail system from substrate.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Corner Guards:
 - 1. Construction Specialties, Inc: www.c-sgroup.com/#sle.
 - 2. Inpro: www.inprocorp.com/#sle.
 - 3. Substitutions: See Section 01 6000 Product Requirements.

2.02 PRODUCT TYPES

- A. Corner Guards Flush Mounted:
 - 1. Material: Type 304 stainless steel, No. 4 finish, _____ gauge, _____ inch thick.
 - 2. Width of Wings: 2 inches.
 - 3. Corner: Square.
 - 4. Color: As selected from manufacturer's standard colors.
 - 5. Length: One piece.

2.03 FABRICATION

- A. Fabricate components with tight joints, corners and seams.
- B. Pre-drill holes for attachment.
- C. Form end trim closure by capping and finishing smooth.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
- B. Verify that substrate surfaces for adhered items are clean and smooth.
- C. Start of installation constitutes acceptance of project conditions.

3.02 INSTALLATION

A. Position corner guard 4 inches above finished floor to 48 inches high.

SECTION 10 2800 TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Commercial toilet accessories.
- B. Commercial shower and bath accessories.
- C. Electric hand/hair dryers.
- D. Utility room accessories.

1.02 RELATED REQUIREMENTS

- A. Section 01 1000 Summary: Owner-Furnished Contractor Installed Toilet Accessories
- B. Section 10 2113.19 Plastic Toilet Compartments.

1.03 REFERENCE STANDARDS

- A. ADA Standards Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- C. ASTM C1036 Standard Specification for Flat Glass; 2016.
- D. ASTM C1503 Standard Specification for Silvered Flat Glass Mirror; 2018.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.05 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Products listed are made by Bobrick, unless otherwise noted.
- B. Other Acceptable Manufacturers:
 - 1. American Specialties, Inc: www.americanspecialties.com.
 - 2. Bradley Corporation: www.bradleycorp.com.
 - 3. Substitutions: Section 01 6000 Product Requirements.
- C. Provide products of each category type by single manufacturer.

2.02 MATERIALS

- A. Accessories General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
 - 1. Grind welded joints smooth.
 - 2. Fabricate units made of metal sheet of seamless sheets with flat surfaces.
- B. Keys: Provide two keys for each accessory to Owner; master key lockable accessories.
- C. Stainless Steel Sheet: ASTM A666, Type 304.
- D. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
- E. Adhesive: Two component epoxy type, waterproof, compliant with project VOC limitations.
- F. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.

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2.03 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.

2.04 COMMERCIAL TOILET ACCESSORIES

- A. Toilet Paper Dispenser: Double roll, surface mounted bracket type, stainless steel.
 - 1. Attached Purse Shelf: 0.03 inch satin finished stainless steel, with rolled or formed edge at front.
 - 2. Product: B-2840 manufactured by Bobrick.
- B. Mirrors: Stainless steel framed, 1/4 inch thick annealed float glass; ASTM C1036.
 - 1. Size: As indicated on drawings.
 - 2. Frame, where indicated: 0.05 inchangle shapes, with mitered and welded and ground corners, and tamperproof hanging system; No.4 finish.
 - 3. Backing: Full-mirror sized, minimum 0.03 inch galvanized steel sheet and nonabsorptive filler material.
 - 4. Product: B-290 manufactured by Bobrick.
 - 5. Mirror M-1:
 - a. Type: Framed.
- C. Seat Cover Dispenser: Stainless steel, surface-mounted, reloading by concealed opening at base.
 - 1. Minimum capacity: 250 seat covers.
 - 2. Product: B-221 manufactured by Bobrick.
- D. Grab Bars: Stainless steel, smooth surface.
 - 1. Standard Duty Grab Bars:
 - a. Push/Pull Point Load: 250 pound-force, minimum.
 - b. Dimensions: 1-1/4 inch outside diameter, minimum 0.05 inch wall thickness, exposed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
 - c. Length and Configuration: As indicated on drawings.
 - d. Products:
 - 1) GB-1: 36 inches, similar to Bobrick 5806.
 - 2) GB-2: 42 inches, similar to Bobrick 5806.
 - 3) GB-3: 18 inches, similar to Bobrick 5806.
 - 4) GB-4: 16 x 31 inches, similar to Bobrick 6861.99.
- E. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, all-welded construction, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.
 - 1. Product: B-270 manufactured by Bobrick.
- F. Wall Hook: Heavy-duty stainless steel, single-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish.
 - 1. Product: B-682 manufactured by Bobrick.

2.05 COMMERCIAL SHOWER AND BATH ACCESSORIES

- A. Shower Curtain Rod: Stainless steel tube, 1 inch outside diameter, 0.04 inch wall thickness, satin-finished, with 3 inch outside diameter, minimum 0.04 inch thick satin-finished stainless steel flanges, for installation with exposed fasteners.
 - 1. Product: B-6107 manufactured by Bobrick.
 - 2. Length: 36 inches.
- B. Shower Curtain:
 - 1. Material: Opaque vinyl, 0.008 inch thick, matte finish, with antibacterial treatment, flameproof and stain-resistant.
 - 2. Size: 48 by 72 inches, hemmed edges.
 - 3. Grommets: Stainless steel; pierced through top hem on 6 inch centers.
 - 4. Color: White.

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- 5. Shower Curtain Hooks: Chrome-plated or stainless steel spring wire designed for snap closure.
- 6. Product: 204-2 curtain with 204-1 hooks manufactured by Bobrick.
- C. Folding Shower Seat: Wall-mounted surface; welded tubular seat frame, structural support members, swing-down legs, hinges, and mechanical fasteners of Type 304 stainless steel, L-shaped, right hand seat.
 - 1. Seat: Phenolic or polymeric composite one-piece seat or seat slats, of color as selected.
 - 2. Size: ADA Standards compliant.

2.06 ELECTRIC HAND/HAIR DRYERS

- A. Electric Hand Dryers: Traditional fan-in-case type, with downward fixed nozzle.
 - 1. Operation: Automatic, sensor-operated on and off.
 - 2. Mounting: Surface mounted.
 - 3. Cover: Aluminum with natural anodized satin finish.
 - a. Tamper-resistant screw attachment of cover to mounting plate.
 - 4. Electric Hand Dryer Products:
 - a. Bobrick B-7180.
 - b. Substitutions: Section 01 6000 Product Requirements.

2.07 UTILITY ROOM ACCESSORIES

- A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
 - 1. Drying rod: Stainless steel, 1/4 inch diameter.
 - 2. Hooks: Three, 0.06 inch stainless steel rag hooks at shelf front.
 - 3. Mop/broom holders: Three spring-loaded rubber cam holders at shelf front.
 - 4. Length: 36 inches.
 - 5. Products:
 - a. Bobrick B-224.
 - b. Substitutions: 01 6000 Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.

3.02 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate, in locations indicated on drawings.
- C. Mounting Heights: As indicated on drawings and required by accessibility regulations, unless otherwise indicated.
- D. Mounting Heights and Locations: As required by accessibility regulations, as indicated on drawings, and as follows:

3.04 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

SECTION 10 4400 FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Fire Department Lock Box.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

- A. FM (AG) FM Approval Guide; current edition.
- B. NFPA 10 Standard for Portable Fire Extinguishers; 2017, with Errata (2018).
- C. UL (DIR) Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
- C. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

1.05 FIELD CONDITIONS

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fire Extinguishers, Cabinets and Accessories:
 - 1. JL Industries, Inc: www.jlindustries.com.
 - 2. Larsen's Manufacturing Co: www.larsensmfg.com.
 - 3. Potter-Roemer: www.potterroemer.com.
 - 4. Substitutions: See Section 01 6000 Product Requirements.

2.02 FIRE EXTINGUISHERS

- A. Fire Extinguishers General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
 - 1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.
 - 2. Provide extinguisher in each cabinet and elsewhere where shown on Drawings.
- B. Multi-Purpose Dry Chemical Type Fire Extinguishers: Heavy duty steel tank, with pressure gage.
 - 1. UL Class: A:B:C.
 - a. 2-A:10B:C (Similar to JL "Cosmic 5E")
 - 2. Finish: Factory powder-coated; Red.
 - 3. Contents: Fluidized and siliconized mono ammonium phosphate powder; nonconductive and nontoxic

2.03 FIRE EXTINGUISHER CABINETS

- A. Similar to JL Industries Cosmopolitan FX2.
- B. Cabinet Configuration: Recessed and Semi-Recessed types.
 - 1. Sized to accommodate extinguisher and accessories.
 - 2. Exterior nominal dimensions of 13 7/8 inch wide by 27 3/8 inch high by 5 7/8 inch deep.
 - 3. Projected Trim: Returned to wall surface, with 3 inch projection, and 2 1/2 inch wide face.

- C. Tub: Primed sheet steel, powder-coated finish.
- D. Door: 0.036 inch thick stainless steel reinforced for flatness and rigidity; latch. Hinge doors for 180 degree opening with continuous piano hinge. Provide nylon catch.
- E. Door Glazing: Float glass, clear, 1/8 inch thick, and set in resilient channel glazing gasket.
- F. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
- G. Fabrication: Weld, fill, and grind components smooth.
- H. Finish of Cabinet Exterior Trim and Door: No.4 Brushed stainless steel.
- I. Finish of Cabinet Interior: White colored enamel.

2.04 FIRE DEPARTMENT LOCK BOX

- A. Manufacturer:
 - 1. KNOXBox www.knoxbox.com/
 - 2. Substitutions: See Section 01 6000 Product Requirements.
- B. Model: KNOXBox 3200 Series Surface Mounted
- C. Key to master key system of fire department having jurisdiction at building site.
- D. Recess mount on wall near front entrance, 60 inches above finished floor, where directed by Architect.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install cabinets plumb and level in wall openings, maximum 54 inches from finished floor to inside top of cabinet.
- C. Secure rigidly in place.
- D. Place extinguishers in cabinets.

3.03 FIELD QUALITY CONTROL

A. Ensure that each extinguisher is fully charged, and that inspection of each extinguisher has been performed, as evidenced by the National Association of Fire Equipment Distributors certification tag, just prior to turnover.

3.04 SCHEDULES

A. See Drawings for type required at each location.

SECTION 10 5113 METAL LOCKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal lockers.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete base construction.

1.03 REFERENCE STANDARDS

- A. ASTM A1008/A1008M Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2021a.
- B. ICC A117.1 Accessible and Usable Buildings and Facilities; 2009

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's published data on locker construction, sizes, and accessories.
- C. Shop Drawings: Indicate locker plan layout, numbering plan.
- D. Samples: Submit two samples six by six inches in size showing color and finish of metal locker material.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect locker finish and adjacent surfaces from damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Lockers:
 - 1. Lyon Workspace Products; ____: www.lyonworkspace.com/#sle.
 - 2. Penco Products, Inc; ____: www.pencoproducts.com/#sle.
 - 3. Republic Storage Systems Co; ____: www.republicstorage.com/#sle.
 - 4. Substitutions: See Section 01 6000 Product Requirements.

2.02 LOCKER APPLICATIONS

- A. Double Tier Lockers: Metal lockers, wall mounted with matching closed base.
 - 1. Width: 12 inches.
 - 2. Depth: 12 inches.
 - 3. Height: 72 inches.
 - 4. Configuration: Two tier.
 - 5. Fittings: Size and configuration as indicated on drawings.
 - a. Hat shelf.
 - b. Hooks: Two single prong.
 - 6. Ventilation: Louvers at top and bottom of door panel.
 - 7. Handle: Recessed.
 - 8. Locking: Padlock hasps, for padlocks provided by Owner.
 - 9. Color: To be selected from manufacturer's full range by Architect.
 - a. Three colors to be selected, as shown on Drawings.
- B. Double Tier Lockers: Metal lockers, free-standing with matching closed base.
 - 1. Width: 12 inches.
 - 2. Depth: 12 inches.
 - 3. Height: 72 inches.
 - 4. Configuration: Two tier.
 - 5. Fittings: Size and configuration as indicated on drawings.

- a. Hat shelf.
- b. Hooks: Two single prong.
- 6. Ventilation: Louvers at top and bottom of door panel.
- 7. Handle: Recessed.
- 8. Locking: Padlock hasps, for padlocks provided by Owner.
- Color: To be selected from manufacturer's full range by Architect.
 a. Three colors to be selected, as shown on Drawings.
- C. Extra Large Vented: Metal lockers, wall mounted with matching closed base.
 - 1. Width: 18 inches.
 - 2. Depth: 24 inches.
 - 3. Height: 72 inches.
 - 4. Configuration: Two tier.
 - 5. Fittings: Size and configuration as indicated on drawings.
 - a. Hat shelf.
 - b. Single shoe shelf.
 - c. Hooks: Two single prong.
 - 6. Ventilation: Full louvers.
 - 7. Handle: Recessed.
 - 8. Locking: Padlock hasps, for padlocks provided by Owner.
 - 9. Color: To be selected from manufacturer's full range by Architect.
 - a. One color to be selected, as shown on Drawings.

2.03 METAL LOCKERS

- A. Locker Case Construction:
 - 1. Standard-Duty, Knocked Down Construction: Made of formed sheet steel; metal edges finished smooth without burrs; baked enamel or powder coat finished inside and out.
 - a. Locker Body Components: Formed and flanged from steel sheet of the following type and minimum thicknesses:
 - 1) Unperforated Steel Sheet: Commercial Steel (CS), Type B, supplied for exposed applications and complying with ASTM A1008/A1008M and the following:
 - 2) Body and Shelves: 24 gauge, 0.0239 inch.
 - 3) Doors:
 - (a) 12 inch wide doors: 18 gauge
 - (b) 18 inch wide doors: 16 gauge.
 - 4) Backs: 24 gauge, 0.0239 inch.
 - 5) Base: 18 gauge, 0.0478 inch.
 - (a) Height: 4 inch. Zee-base.
 - b. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.
 - 1) Door Frame: 16 gauge, 0.0598 inch, minimum.
 - c. Where ends or sides are exposed, provide flush panel closures.
 - d. Provide filler strips where indicated, securely attached to lockers.
- B. Latches and Door Handles: Manufacturer's standard.
- C. Hinges: Heavy-duty, 5-knuckle type; two for doors under 42 inches high; three for doors over 42 inches high.
- D. Trim: 20 gauge, 0.0359 inch.
- E. Coat Hooks: Stainless steel or zinc-plated steel.
- F. Locks: Locker manufacturer's standard type indicated in Applications article above.
- G. Finish: Manufacturer's standard powder-coating.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Place and secure on prepared base.
- C. Install lockers plumb and square.
- D. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 pounds.
- E. Bolt adjoining locker units together to provide rigid installation.
- F. Install end panels, filler panels, and base panels.
- G. Install fittings if not factory installed.
- H. Replace components that do not operate smoothly.

3.02 CLEANING

A. Clean locker interiors and exterior surfaces.

SECTION 10 7500 FLAGPOLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aluminum Flagpoles.
- B. Flags.

1.02 REFERENCE STANDARDS

- A. ASTM B241/B241M Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube; 2016.
- B. NAAMM FP 1001 Guide Specifications for Design Loads of Metal Flagpoles; 2007.

1.03 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on pole, accessories, and configurations.
- C. Shop Drawings: Indicate detailed dimensions, base details, anchor requirements, and imposed loads.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Spiral wrap flagpole with protective covering and pack in protective shipping tubes or containers.
- B. Protect flagpole and accessories from damage or moisture.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Flagpoles:
 - 1. Basis of Design: Concord American Flagpole; External Continental: with American Beacon External Halyard lighting. www.concordamericanflagpole.com/#sle.
 - 2. American Flagpole: www.americanflagpole.com..
 - 3. Substitutions: See Section 01 6000 Product Requirements.

2.02 FLAGPOLES

- A. Flagpoles: Designed in accordance with NAAMM FP 1001.
 - 1. Material: Aluminum.
 - 2. Design: Cone tapered.
 - 3. Mounting: Vertical wall mounted type.
 - 4. Outside Tip Diameter: 4" inches.
 - 5. Nominal Wall Thickness: 0.188 inches.
 - 6. Nominal Height: 35 ft; measured from top of base.
 - 7. Halyard: External type, cleat.
- B. Performance Requirements:
 - 1. Wind Pressure Loading on Flagpole with Flag: Resistant without permanent deformation to 90 miles/hr wind speed, in accordance with NAAMM FP 1001; the factor of safety used is 2.5.

2.03 POLE MATERIALS

A. Aluminum: ASTM B241/B241M, 6063 alloy, T6 temper.

2.04 ACCESSORIES

- A. Truck Assembly: Cast aluminum; revolving, stainless steel ball bearings, non-fouling.
- B. Flag: US design design, 5 ft by 8 ft (1.5 m by 2.4 m) size, nylon fabric, brass grommets, hemmed edges

- C. Flag: Oregon State design design, 5 ft by 8 ft size, nylon fabric, brass grommets, hemmed edges.
- D. Flag: National League of Families' POW/MIA design, 5 ft by 8 ft (1.5 m by 2.4 m) size, nylon fabric, brass grommets, hemmed edges
- E. Cleats: 9 inch size, aluminum with galvanized steel fastenings, one per halyard.
- F. Cleat Box: Aluminum, with built-in hinge and hasp assembly, attached to pole with tamper proof screws inside box.
- G. Halyard: 5/16 inch diameter nylon, braided, white.
- H. Lighting: Halyard lighting, 500 lumens, pre-wired flagpole.

2.05 MOUNTING COMPONENTS

A. Wall Support Assembly: Galvanized steel; round; one piece assembly, back-plate for through bolting, with galvanized steel anchor bolts and cover.

2.06 FINISHING

- A. Aluminum: Mill finish.
- B. Finial: Gold anodized finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that wall supports are ready to receive work and dimensions are as indicated on shop drawings.

3.02 INSTALLATION

- A. Install flagpole and fittings in accordance with manufacturer's instructions.
- B. Set brackets for wall set flagpoles anchored securely into wall construction. Seal watertight.

3.03 TOLERANCES

A. Maximum Variation From Plumb: 1 inch.

3.04 ADJUSTING

A. Adjust operating devices so that halyard and flag function smoothly.

SECTION 11 3013 RESIDENTIAL APPLIANCES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Kitchen appliances.

1.02 RELATED REQUIREMENTS

- A. Division 22: Plumbing connections for appliances.
- B. Division 26: Electrical connections for appliances.

1.03 REFERENCE STANDARDS

A. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data indicating dimensions, capacity, and operating features of each piece of residential equipment specified.
- C. Copies of Warranties: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Electric Appliances: Listed and labeled by UL (DIR) and complying with NEMA Standards (National Electrical Manufacturers Association).
- C. Gas Appliances: Bearing design certification seal of American Gas Association (AGA).
- D. Energy Ratings: Provide energy guide labels with energy cost analysis (annual operating costs) and efficiency information as required by Federal Trade Commission.

1.06 WARRANTY

- A. See Section 01 7800 Closeout Submittals, for additional warranty requirements.
- B. Submit manufacturer's standard written warranty for each item of residential equipment.
- C. Provide five (5) year manufacturer warranty on refrigeration system of refrigerators.
- D. Provide ten (10) year manufacturer warranty on magnetron tube of microwave ovens.
- E. Provide ten (10) year manufacturer warranty on tub and door liner of dishwashers.

PART 2 PRODUCTS

2.01 KITCHEN APPLIANCES

- A. Provide Equipment Eligible for Energy Star Rating: Energy Star Rated.
- B. Refrigerator, Type 1: Free-standing, French Door, and frost-free.
 - 1. Capacity: Total minimum storage of 27.7 cubic ft; minimum 15 percent freezer capacity.
 - 2. Energy Usage: Minimum 20 percent more energy efficient than energy efficiency standards set by U.S. Department of Energy (DOE).
 - 3. Features: Include glass shelves, automatic icemaker, and light in freezer compartment.
 - 4. Energy Star Rated.
 - 5. Exterior Finish: Stainless steel, color as indicated.
 - 6. Manufacturers:
 - a. Frigidaire Home Products; ____: www.frigidaire.com/#sle.
 - b. GE Appliances; ____: www.geappliances.com/#sle.
 - c. Whirlpool Corp; ____: www.whirlpool.com/#sle.
 - d. Substitutions: See Section 01 6000 Product Requirements.

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- C. Microwave: Countertop.
 - 1. Capacity: 1.6 cubic ft.
 - 2. Power: 1000 watts.
 - 3. Features: Include turntable.
 - 4. Exterior Finish: Stainless Steel.
 - 5. Manufacturers:
 - a. GE Appliances; ____: www.geappliances.com/#sle.
 - b. Substitutions: See Section 01 6000 Product Requirements.
- D. Dishwasher: Undercounter.
 - 1. Controls: Solid state electronic.
 - 2. Wash Levels: Three (3).
 - 3. Cycles: Four (4), including normal and short.
 - 4. Features: Include rinse aid dispenser and adjustable upper rack.
 - 5. Exterior Finish: Stainless steel.
 - Tub Material: Stainless steel 6.
 - 7. Width: 24 inches.
 - 8. Height: For installation below 34 inch counters as shown on Drawings.
 - 9. Energy Star Rated.
 - 10. Manufacturers:
 - a. Bosch; Product SGE53X55UC.
 - b. GE Appliances; ____: www.geappliances.com/#sle.c. Whirlpool Corp; ___: www.whirlpool.com/#sle.

 - d. Substitutions: See Section 01 6000 Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify utility rough-ins are provided and correctly located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Anchor built-in equipment in place.

3.03 ADJUSTING

A. Adjust equipment to provide efficient operation.

3.04 CLEANING

- A. Remove packing materials from equipment and properly discard.
- B. Wash and clean equipment.

SECTION 12 2400 WINDOW SHADES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior manual roller shades.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

1.03 REFERENCE STANDARDS

- A. ASTM G21 Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.
- B. NFPA 701 Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2019.
- C. UL 325 Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.
- D. WCMA A100.1 Safety of Window Covering Products; 2018.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
- C. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.
- D. Verification Samples: Minimum size 6 inches square, representing actual materials, color and pattern.
- E. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.
- B. Handle and store shades in accordance with manufacturer's recommendations.

1.07 WARRANTY

- A. See Section 01 7800 Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
 - 1. Shade Hardware: One year.
 - 2. Fabric: One year.
 - 3. Aluminum and Steel Coatings: One year.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Interior Manually Operated Roller Shades:

- 1. Draper, Inc; Clutch Operated FlexShade: www.draperinc.com/#sle.
- 2. Hunter Douglas Architectural; RB500 Manual Roller Shades: www.hunterdouglasarchitectural.com/#sle.
- 3. MechoShade Systems LLC; Mecho/5 System: www.mechoshade.com/#sle.
- 4. Substitutions: See Section 01 6000 Product Requirements.

2.02 ROLLER SHADES

- A. General:
 - 1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
 - 2. Provide shade system that operates smoothly when shades are raised or lowered.
- B. Roller Shades:
 - 1. Description Interior Roller Shades: Single roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
 - a. Drop Position: Regular roll.
 - b. Roll Direction: Roll down, closed position is at window sill.
 - c. Mounting: Wall mounted.
 - d. Size: As indicated on drawings.
 - e. Fabric: As indicated under Shade Fabric article.
 - 2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
 - 3. Roller Tubes: As required for type of shade operation.
 - a. Material: Extruded aluminum, clear anodized finish.
 - b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
 - 4. Hembars: Designed to maintain bottom of shade straight and flat.
 - a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.
 - 5. Manual Operation for Interior Shades:
 - a. Clutch Operator: Manufacturer's standard material and design, permanently lubricated.
 - b. Drive Chain: Continuous loop beaded ball chain, 95 pounds minimum breaking strength. Provide upper and lower limit stops.
 - c. Shade Lift Assistance: Manufacturer's standard spring device contained in the idler end of roller tube to reduce force required to lift shades; as required based on shade weight.

2.03 SHADE FABRIC

- A. Fabric for Light-Filtering Shades: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
 - 1. Material: Vinyl coated polyester.
 - 2. Openness Factor: 1 percent.
 - 3. Color: As selected by Architect from manufacturer's full range of colors.

2.04 ROLLER SHADE FABRICATION

- A. Field measure finished openings prior to ordering or fabrication.
- B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
 - 1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch space between bottom bar and window stool.
 - 2. Horizontal Dimensions Inside Mounting: Provide symmetrical light gaps on both sides of shade not to exceed 3/4 inch total.
- C. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine finished openings for deficiencies that may preclude satisfactory installation.
- B. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION

- A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.
- B. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.
- B. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.04 CLEANING

- A. Clean soiled shades and exposed components as recommended by manufacturer.
- B. Replace shades that cannot be cleaned to "like new" condition.

3.05 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

3.06 PROTECTION

- A. Protect installed products from subsequent construction operations.
- B. Touch-up, repair, or replace damaged products before Substantial Completion.

SECTION 12 3600 COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Countertops for architectural cabinet work.
- B. Wall-hung counters and vanity tops.

1.02 RELATED REQUIREMENTS

A. Section 06 4100 - Architectural Wood Casework.

1.03 REFERENCE STANDARDS

- A. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- B. AWI/AWMAC/WI (AWS) Architectural Woodwork Standards; 2014, with Errata (2018).
- C. ISFA 2-01 Classification and Standards for Solid Surfacing Material; 2013.
- D. NEMA LD 3 High-Pressure Decorative Laminates; 2005.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- 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. Specimen warranty.
- C. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.
- D. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product, color, and patterns.
- E. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 COUNTERTOPS

- A. Quality Standard: See Section 06 4100.
- B. Plastic Laminate Countertops PL-2: High-pressure decorative laminate (HPDL) sheet bonded to substrate.
 - 1. Laminate Sheet: NEMA LD 3, Grade HGS, 0.044 inch nominal thickness.
 - a. Manufacturers:
 - 1) Formica Corporation: www.formica.com.
 - 2) Lamin-Art, Inc.: www.laminart.com.

- 3) Panolam Industries International, Inc.\Nevamar: www.nevamar.com.
- 4) Panolam Industries International, Inc.\Pionite: www.pionitelaminates.com.
- 5) Wilsonart: www.wilsonart.com/#sle.
- 6) Substitutions: See Section 01 6000 Product Requirements.
- b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
- c. Finish: Matte or suede, gloss rating of 5 to 20.
- d. Surface Color and Pattern: As indicated on drawings.
- 2. Exposed Edge Treatment: Square, substrate built up to minimum 1 1/2 inch thick; covered with matching laminate.
- 3. Back and End Splashes: Same material, same construction. Where indicated on drawings.
- C. Plastic Laminate Countertops PL-4: Solid through-color high pressure laminate sheet bonded to substrate.
 - 1. Laminate Sheet: NEMA LD 3, Grade HGS, 0.044 inch nominal thickness.
 - a. Manufacturers:
 - 1) Formica Corporation; Colorcore2: www.formica.com.
 - 2) Lamin-Art, Inc.: www.laminart.com.
 - 3) Substitutions: See Section 01 6000 Product Requirements.
 - b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.c. Finish: Matte or suede, gloss rating of 5 to 20.
 - Exposed Edge Treatment: Square, substrate built up to minimum [1 1/2] inch thick; covered with matching laminate.

- D. Solid Surfacing Countertops SSM-1 & SSM-2: Solid surfacing sheet or plastic resin casting over continuous substrate.
 - 1. Flat Sheet Thickness: 1/2 inch, minimum.
 - 2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 - a. Manufacturers:
 - 1) Formica Corporation: www.formica.com.
 - 2) Avonite Surfaces: www.avonitesurfaces.com.
 - 3) Dupont: www.corian.com.
 - 4) Substitutions: See Section 01 6000 Product Requirements.
 - b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
 - c. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
 - d. Color and Pattern: As indicated on drawings.
 - 3. Other Components Thickness: 1/2 inch, minimum.
 - 4. Back and End Splashes: Same sheet material, square top; minimum 4 inches high. Where indicated on drawings.
- E. Quartz Countertops QTZ: Sheet of quartz over continuous substrate.
 - 1. Material: Quartz
 - 2. Manufacturer and Product:
 - a. Ceasarstone: www.caesarstoneus.com/
 - b. Substitutions: See Section 01 6000 Product Requirements.
 - 3. Color and Pattern: As indicated on drawings.
 - 4. Thickness: 2 cm
 - 5. Finish: Polished
 - 6. Exposed Edge Treatment: Square, basic eased

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2.02 MATERIALS

- A. Wood-Based Components: As specified in Section 06 4100.
- B. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

2.03 FABRICATION

- A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
 - 1. Join lengths of tops using best method recommended by manufacturer.
 - 2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
 - 3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B. Provide back/end splash wherever counter edge abuts vertical surface as noted on the drawings.
 - 1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
 - 2. Height: 4 inches, unless otherwise indicated.
- C. Solid Surfacing: Fabricate tops and wall panels up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.
- D. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated on drawings, finished to match.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 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.

3.03 INSTALLATION

- A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- B. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch.
- C. Seal joint between back/end splashes and vertical surfaces.

3.04 TOLERANCES

- A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.
- B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.
- C. Field Joints: 1/8 inch wide, maximum.

3.05 CLEANING

A. Clean countertops surfaces thoroughly.

3.06 PROTECTION

A. Protect installed products until completion of project.
B. Touch-up, repair or replace damaged products before Date of Substantial Completion. END OF SECTION

SECTION 14 2400 HYDRAULIC ELEVATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Complete hydraulic elevator systems.
 - 1. Passenger type.
- B. Elevator Maintenance Contract.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 Cast-in-Place Concrete: Includes elevator machine foundation, elevator pit, and grouting thresholds.
- B. Section 05 5000 Metal Fabrications: Includes elevator pit ladder, sill supports, and overhead hoist beams.
- C. Section 07 1400 Fluid-Applied Waterproofing: Waterproofing of elevator pit walls and floor.
- D. Section 07 8400 Firestopping: Fire rated sealant in hoistway.
- E. Section 08 3100 Access Doors and Panels: Fire rated access doors into hoistway.
- F. Section 09 2116 Gypsum Board Assemblies: Gypsum shaft walls.
- G. Section 14 2400.1 Elevator Maintenance: Scope of Maintenance Agreement after expiration of 1 year Warranty Preventive Maintenance period
- H. Section 21 1300 Fire-Suppression Sprinkler Systems: Sprinkler heads in hoistway.
- I. Section 26 0533.13 Conduit for Electrical Systems:
- J. Section 26 0583 Wiring Connections:
- K. Section 28 4600 Fire Detection and Alarm:
 - 1. Fire and smoke detectors and interconnecting devices.
 - 2. Fire alarm signal lines to elevator controller cabinet.

1.03 REFERENCE STANDARDS

- A. ADA Standards Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. AISC 360 Specification for Structural Steel Buildings; 2016.
- C. ASCE 7 Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- D. ASME A17.1 Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices; 2019, with Errata (2021).
- E. ASME A17.2 Guide for Inspection of Elevators, Escalators, and Moving Walks; 2017.
- F. ASME QEI-1 Standard for the Qualification of Elevator Inspectors; 2018.
- G. ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- H. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- I. ASTM B209M Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- J. AWS D1.1/D1.1M Structural Welding Code Steel; 2020, with Errata (2021).
- K. NFPA 70 National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. NFPA 80 Standard for Fire Doors and Other Opening Protectives; 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

- 1. Coordinate work with other installers to provide conduits necessary for installation of wiring including but not limited to:
 - a. Elevator pit for lighting and sump pump.
 - b. Fire alarm panel from controller cabinet.
- 2. Coordinate work with other installers for equipment provisions necessary for proper elevator operation, including but not limited to, the following:
 - a. Automatic transfer switches with auxiliary contacts for emergency power transfer status indication.
 - b. Shunt trip devices for automatic disconnection of elevator power prior to fire suppression system activation.
 - c. Overcurrent protection devices selected to achieve required selective coordination.
- B. Preinstallation Meeting: Convene meeting at least one week prior to start of this work.
 - 1. Review schedule of installation, proper procedures and conditions, and coordination with related work.
 - 2. Review use of elevator for construction purposes, hours of use, scheduling of use, cleanliness of car, employment of operator, and maintenance of system.
- C. Construction Use of Elevator: Not permitted.

1.05 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Submit data on following items:
 - 1. Signal and operating fixtures, operating panels, and indicators.
 - 2. Car design, dimensions, layout, and components.
 - 3. Car and hoistway door and frame details.
 - 4. Electrical characteristics and connection requirements.
 - 5. Expected heat dissipation of elevator equipment in hoistway (BTU).
- C. Shop Drawings: Include appropriate plans, elevations, sections, diagrams, and details on following items:
 - 1. Elevator Equipment and Machines: Size and location of driving machines, power units, controllers, governors, and other components.
 - 2. Hoistway Components: Size and location of car guide rails, buffers, jack unit and other components.
 - 3. Rail bracket spacing; maximum loads imposed on guide rails requiring load transfer to building structural framing.
 - 4. Clearances and over-travel of car.
 - 5. Locations in hoistway of traveling cables and connections for car lighting and telephone.
 - 6. Location and sizes of hoistway and car doors and frames.
 - 7. Calculated heat dissipation of elevator equipment in machine room.
 - 8. Electrical characteristics and connection requirements.
 - 9. Indicate arrangement of elevator equipment and allow for clear passage of equipment through access openings.
- D. Testing Agency's Qualification Statement.
- E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- F. Initial Maintenance Contract.
- G. Maintenance Contract: Submit proposal to Owner for standard five year continuing maintenance contract agreement in accordance with ASME A17.1 and requirements as indicated in Section 14 2400.1 Elevator Maintenance, starting on date initial maintenance contract is scheduled to expire.

- 1. Indicate in proposal the services, obligations, conditions, and terms for agreement period and for renewal options.
- H. Operation and Maintenance Data:
 - 1. Parts catalog with complete list of equipment replacement parts; identify each entry with equipment description and identifying code.
 - 2. Operation and maintenance manual.
 - 3. Schematic drawings of equipment and hydraulic piping, and wiring diagrams of installed electrical equipment with list of corresponding symbols to identify markings on machine room and hoistway apparatus.

1.06 QUALITY ASSURANCE

- A. Maintain one copy of each quality standard document on site.
- B. Installer Qualifications: Company specializing in performing the work of this section and approved by elevator equipment manufacturer.
- C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of type specified in this section.

1.07 WARRANTY

- A. See Section 01 7800 Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturer's warranty for elevator operating equipment and devices for one year from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Hydraulic Elevators: OTIS Elevator Company; Hydrofit; hole-less, machine-room-less, hydraulic elevator.
- B. Other Acceptable Manufacturers Hydraulic Elevators:1. ThyssenKrupp Elevator: www.thyssenkruppelevator.com.
- C. Substitutions: See Section 01 6000 Product Requirements.
 - 1. For any product not identified as Basis of Design, submit information as specified for substitutions.
- D. Products other than Basis of Design are subject to compliance with specified requirements and prior approval of Architect. By using products other than Basis of Design, the Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.
- E. Source Limitations: Provide elevator and associated equipment and components produced by the same manufacturer as the other elevator equipment used for this project and obtained from a single supplier.

2.02 HYDRAULIC ELEVATORS

- A. Hydraulic Passenger Elevator:
 - 1. Hydraulic Elevator Equipment:
 - a. Holeless hydraulic with cylinder mounted within hoistway.
 - 2. Operation Control Type:
 - a. Single Automatic Operation Control.
 - 3. Service Control Type:
 - a. Standard service control only.
 - 4. Interior Car Height: 93 inch.
 - 5. Electrical Power: 208 volts; alternating current (AC); three phase; 60 Hz.
 - 6. Rated Net Capacity: 2500 pounds.
 - 7. Rated Speed: 100 feet per minute.
 - 8. Hoistway Size: As indicated on drawings.
 - 9. Interior Car Platform Size: As indicated on drawings.

- 10. Elevator Pit Depth: As indicated on drawings.
- 11. Overhead Clearance at Top Floor: 148 inch.
- 12. Travel Distance: As indicated on drawings.
- 13. Number of Stops: As indicated on drawings.
- 14. Number of Openings: one Front.
- 15. Hydraulic Equipment Location: Adjacent to bottom of hoistway shaft

2.03 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1, applicable local codes, and authorities having jurisdiction (AHJ).
- B. Accessibility Requirements: Comply with ADA Standards.
- C. Perform structural steel design, fabrication, and installation in accordance with AISC 360.
- D. Comply with seismic design requirements in accordance with ASME A17.1, applicable local codes, and authorities having jurisdiction (AHJ).
 - 1. Complying with Elevator Safety Requirements for Seismic Risk Zone in accordance with ASME A17.1, ASCE 7 and other related requirements.
 - a. Project Seismic Risk: As indicated on drawings.
 - 2. Provide earthquake emergency operations in accordance with ASME A17.1 requirements.
- E. Perform welding of steel in accordance with AWS D1.1/D1.1M.
- F. Fabricate and install door and frame assemblies in accordance with NFPA 80 and in compliance with requirements of authorities having jurisdiction.
- G. Perform electrical work in accordance with NFPA 70.

2.04 OPERATION CONTROLS

- A. Elevator Controls: Provide landing operating panels and landing indicator panels.
 - 1. Landing Operating Panels: Metallic type, one button only at terminating landings; with illuminating indicators.
 - 2. Landing Indicator Panels: Illuminating.
 - 3. Comply with ADA Standards for elevator controls.
- B. Interconnect elevator control system with building security, fire alarm, and smoke alarm systems.
- C. Door Operation Controls:
 - 1. Program door control to open doors automatically when car arrives at floor landing.
 - 2. Render "Door Close" button inoperative when car is standing at dispatch landing with doors open.
 - 3. Door Safety Devices: Moveable, retractable safety edges, quiet in operation; equipped with photo-electric light rays.

2.05 OPERATION CONTROL TYPE

- A. Single Automatic (Push Button) Operation Control: Applies to car in single elevator shaft.
 - 1. Refer to description provided in ASME A17.1.
 - 2. Set system operation so that momentary pressure of landing button dispatches car from other landing to that landing.
 - 3. Allow call registered by momentary pressure of landing button at any time to remain registered until car stops in response to that landing call.
 - 4. If elevator car door is not opened within predetermined period of time after car has stopped at terminal landing allow car to respond to call registered from other landing.

2.06 MATERIALS

- A. Stainless Steel Sheet: ASTM A666, Type 304; No. 4 Brushed finish unless otherwise indicated.
- B. Aluminum Sheet: ASTM B209 (ASTM B209M), 3105 alloy, O temper.

2.07 CAR AND HOISTWAY ENTRANCES

A. Elevator.:

- 1. Car and Hoistway Entrances, Main Elevator Lobby:
 - a. Framed Opening Finish and Material: Brushed stainless steel.
 - b. Car Door Material: Stainless steel, with rigid sandwich panel construction.
 - c. Hoistway Door Material: Stainless steel, with rigid sandwich panel construction.

2.08 CAR EQUIPMENT AND MATERIALS

- A. Elevator Car:
 - 1. Car Operating Panel: Provide main and auxiliary; flush-mounted applied face plate, with illuminated call buttons corresponding to floors served with "Door Open/Door Close" buttons, "Door Open" button, "Door Close" button, and alarm button.
 - a. Panel Material: Integral with front return; one per car.
 - b. Car Floor Position Indicator: Above door with illuminating position indicators.
 - c. Locate alarm button where it is unlikely to be accidentally actuated; not more than 54 inch above car finished floor.
 - 2. Flooring: Carpeting.
 - 3. Front Return Panel: Match material of car door.
 - 4. Door Wall: Stainless steel.
 - 5. Hand Rail: Stainless steel, at rear wall. Provide open clearance space 1-1/2 inch (38 mm) wide to face of wall.
 - a. Stainless Steel Finish: No. 4 Brushed.
 - 6. Ceiling:
 - a. Lay-in Panel: Aluminum sheet.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting this work.
- B. Verify that hoistway, pit, machine room, and related support surfaces are ready for work of this section.
- C. Verify hoistway shaft and openings are of correct size and within tolerance.
- D. Verify location and size of machine foundation and position of machine foundation bolts.
- E. Verify that electrical power is available and of correct characteristics.

3.02 PREPARATION

- A. Arrange for temporary electrical power for installation work and testing of elevator components, and comply with requirements of Section 01 5000 Temporary Facilities and Controls.
- B. Maintain elevator pit excavation free of water.

3.03 INSTALLATION

- A. Coordinate this work with installation of hoistway wall construction.
- B. Install system components, and connect equipment to building utilities.
- C. Provide conduit, electrical boxes, wiring, and accessories. Refer to Sections 26 0533.13 and 26 0583.
- D. Install hydraulic piping between cylinder and pump unit.
- E. Mount machines, motors, and pumps on vibration and acoustic isolators.
 - 1. Place on structural supports and bearing plates.
 - 2. Securely fasten to building supports.
 - 3. Prevent lateral displacement.
- F. Install hoistway, elevator equipment, and components in accordance with approved shop drawings.

- G. Install guide rails to allow for thermal expansion and contraction movement of guide rails.
- H. Accurately machine and align guide rails, forming smooth joints with machined splice plates.
- I. Install hoistway door sills, frames, and headers in hoistway walls; grout sills in place, set hoistway floor entrances in alignment with car openings, and align plumb with hoistway.
- J. Structural Metal Surfaces: Clean surfaces of rust, oil or grease; wipe clean with solvent; prime two coats.
- K. Wood Surfaces not Exposed to Public View: Finish with one coat primer; one coat enamel.
- L. Adjust equipment for smooth and quiet operation.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 Quality Requirements, for additional requirements.
- B. Perform testing and inspection in accordance with requirements.
 - 1. Inspectors shall be certified in accordance with ASME QEI-1.
 - 2. Perform tests as required by ASME A17.2.
 - 3. Provide at least two weeks written notice of date and time of tests and inspections.
 - 4. Supply instruments and execute specific tests.
- C. Operational Tests:
 - 1. Perform operational tests in the presence of Owner and Architect.
 - 2. At an agreed time, and the building occupied with normal building traffic, conduct tests to verify performance.
 - a. Furnish event recording of each landing call registrations, time initiated, and response time throughout entire working day.

3.05 ADJUSTING

- A. Adjust for smooth acceleration and deceleration of car to minimize passenger discomfort.
- B. Adjust with automatic floor leveling feature at each floor landing to reach 1/4 inch maximum from flush with sill.

3.06 CLEANING

- A. Remove protective coverings from finished surfaces.
- B. Clean surfaces and components in accordance with manufacturers written instructions.

3.07 CLOSEOUT ACTIVITIES

A. Demonstrate proper operation of equipment to Owner's designated representative.

3.08 PROTECTION

- A. Do not permit construction traffic within car after cleaning.
- B. Protect installed products until Date of Substantial Completion.
- C. Touch-up, repair, or replace damaged products and materials prior to Date of Substantial Completion.

3.09 MAINTENANCE

- A. Refer to Section 01 7000 Execution and Closeout Requirements, for additional requirements relating to initial maintenance service.
- B. Provide Initial Maintenance Contract of elevator system and components in accordance with ASME A17.1 and requirements as indicated for 12 months from Date of Substantial Completion.
- C. Perform maintenance contract services using competent and qualified personnel under the supervision and direct employ of the elevator manufacturer or original installer.
- D. Maintenance contract services shall not be assigned or transferred to any agent or other entity without prior written consent of Owner.

- E. Examine system components periodically.
- F. Include systematic examination, adjustment, and lubrication of elevator equipment.
- G. Maintain and repair or replace parts, whenever required, using parts produced by original equipment manufacturer.
- H. Perform work without removing cars from use during peak traffic periods.
- I. Provide emergency call back service during regular working hours throughout period of this maintenance contract.
- J. Maintain an adequate stock of parts for replacement or emergency purposes, and have personnel available to ensure the fulfillment of this maintenance contract without unreasonable loss of time.

END OF SECTION

SECTION 21 0500

GENERAL FIRE PROTECTION PROVISIONS

PART 1 GENERAL

1.01 CONTRACT DOCUMENTS

- A. General fire protection provisions apply to all work performed in Division 21.
- B. The Contract Documents are complementary. What is required by anyone, as affects this Division, shall be as binding as if repeated herein.
- C. Separation of this Division from other Contract Documents shall not be construed as segregation of the Work.
- D. Location of equipment on Drawings is approximate. Plan exact location with respect to site measurements and work of other trades prior to starting work. If measurements differ slightly, modify work. If measurements differ substantially, notify Architect/Engineer and Owner's Authorized Representative prior to fabrication.
- E. Make minor changes in equipment connections and equipment locations as directed or required before rough-in without extra cost.
- F. For products specified by listing one or more manufacturers, followed by "Similar to" and one manufacture's model number, the following requirements apply:
 - 1. Approval of each listed manufacturer is contingent upon that manufacturer having a product which meets the specification, fits in the available space, and is comparable to the listed model.
 - 2. Electrical requirements, duct requirements, pipe connections, and space requirements indicated on drawings are based on the listed model and may not be suitable for all manufacturers listed. Provide revisions required to accommodate the model actually furnished.
- G. For product specified by listing one or more manufacturers, followed by a model number for each manufacturer, the following requirements apply:
 - 1. Provide one of the listed model numbers or an approved substitution.
 - 2. Electrical requirements, duct connections, pipe connections, and space requirements indicated on the Drawings are based on one of the listed models, and may not be suitable for all models listed. Provide revisions required to accommodate the model actually furnished.

1.02 DEFINITIONS

- A. Authority Having Jurisdiction (AHJ): The governmental agency or sub-agency which regulates the construction process.
- B. Owner's Authorized Representative (OAR): Owner's representative with authority to act on Owner's behalf.
- C. Provide: Equivalent to "Furnish and Install."

1.03 COORDINATION

- A. Check drawings of other trades to avert possible installation conflicts. Should major changes from original drawings be necessary to resolve such conflicts, notify Architect/Engineer and secure written approval and agreement on necessary adjustments before start of work.
- B. Architectural drawings govern all other drawings. Consult in detail the door swings, counter heights and similar items affecting work before rough-in.
- C. Coordinate identification systems with other trades. All mechanical systems shall use identical piping, valve, and equipment identification and regulatory signage.

1.04 SUBMITTALS AND SHOP DRAWINGS

- A. See Division 01
- B. Action Submittal Content

- 1. Action submittal information not expressly required by the specifications will not be reviewed.
- 2. Action submittal information shall be provided in sufficient detail to establish conformance with specified requirements. Where submitted literature includes multiple models, features, or options, the specific models, features, or options proposed shall be clearly indicated. Where a brief inspection shows that product data is not complete, the submittal will be rejected without review.
- 3. Action submittal data shall be clear, concise, legible, and relevant. Where data is not properly organized and contains significant information that is not relevant, the submittal will be rejected without review.
- 4. Action submittal requirements will be listed in individual specification sections. The following definitions apply.
 - a. Materials List: Provide tabular list of materials including specification reference, specification product name, manufacturer, model/part number, and size and/or quantity where appropriate. Do not include supplemental data, except where specifically requested.
 - b. Catalog data: Manufacturer's standard product cut sheet.
 - c. Product Data: Detailed data including dimensions, weight, materials of construction, connections, and all other information needed to confirm that the product conforms to all requirements listed in the individual specification section.
 - d. Performance Data: Capacity, input, output, flow, etc. as required to confirm that the product meets the performance requirements scheduled in the Specifications or on the Drawings.
 - e. Wiring Diagrams: Power and control wiring diagrams.
 - f. Shop Drawings: Construction drawings of items manufactured specifically for this project including dimensions, construction details, weights, and additional information to identify the physical features of the system or piece of equipment.
 - g. Installation Instructions.
 - h. Special Requirements Listed: Additional requirements indicated in individual specification sections.

C. Delegated Design

1.

- Delegated work will include:
 - a. Section 21 13 13 Wet-Pipe Sprinkler Systems
- b. Section 21 13 16 Dry Pipe Sprinkler Systems
- 2. 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.
 - a. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.

1.05 QUALITY ASSURANCE

- A. All materials and equipment provided hereunder shall be installed and started in complete conformance with the manufacturer's recommendations.
- B. Asbestos products or equipment or materials containing asbestos shall not be used.

1.06 DESIGN REQUIREMENTS

- A. Materials and equipment provided hereunder shall be rated for the service conditions of the system to which they are connected including but not limited to temperature, pressure, and humidity.
- B. Materials and equipment provided hereunder shall comply with the USDOT FTA Buy America Requirements (49 CFR 661).

1.07 CODES AND STANDARDS

A. Applicable codes and standards shall determine minimum requirements for materials, methods, and labor practices not otherwise stated herein.

B. Work shall comply with the Americans with Disabilities Act (ADA).

1.08 TEMPORARY SERVICES

A. Provide in accordance with Division 01 as required for completion of work.

1.09 OPERATIONS AND MAINTENANCE MANUALS

- A. Provide manuals as noted in Division 01, clearly indexed and bookmarked for each item or product. Index tabs shall match submittal schedule and include any additional information required for operations and maintenance, whether in submitted schedule or not.
- B. Maintenance instructions shall indicate routine-type work with step-by-step instructions that should be performed to ensure long life and proper operations. Recommended frequency of performance shall also be included.
- C. Provide copy of approved submittal for each product included in manual.
- D. Provide electronic configuration files for all packaged equipment control systems furnished with equipment.
- E. Mark the model actually provided where the literature covers more than one model. Include four copies of all submittal data corrected to "as-built" conditions within the manual.
- F. Provide a composite summary table indicating each item of equipment listed in the operations and maintenance manual and its required maintenance and time period. This summary table shall be the first section in the O&M manual.
- G. Manual Content: Manuals shall contain complete information for each item of mechanical electrical or other operating equipment. Include as applicable:
 - 1. Manufacturer's instructions for installation, startup, operation, inspection, and maintenance
 - 2. Lubrication schedules
 - 3. Performance capacity
 - 4. Catalog data sheets
 - 5. Parts list
 - 6. Maintenance schedules

1.10 RECORD DRAWINGS

A. Provide record "as-built" drawings in accordance with Division 1 requirements. Show all deviations from contract drawings and location of underground lines by accurate dimensions from building lines. Show depth of all stub outs and underground lines. Dimension all concealed piping from column grids or building lines. Transfer all information to one hard copy of drawings at completion of project. Alternately, provide electronically using .pdf markup of contract drawings.

1.11 DEMONSTRATION

- A. General: After installation is complete, demonstrate to Authority Having Jurisdiction and Owner's Authorized Representative's satisfaction as being complete and operational and entirely in conformance with Contract Documents.
- B. Arrange for demonstration with Owner and Authority Having Jurisdiction at least one week in advance of demonstration.

PART 2 PRODUCTS

2.01 PRODUCTS AND MATERIALS

- A. All materials employed in permanent construction shall be new, full weight, in first class condition, and suitable for space provided. All similar materials shall be of one manufacturer.
- B. Equipment used as the basis of design is scheduled on drawings or designated in product specifications. If Contractor chooses to use equipment that is not the basis of design, Contractor is responsible for all re-design and construction costs associated with variations in arrangement, dimension, or capacity. Such work may include, but is not limited to, changes to

facility structure or dimensions and revisions to associated mechanical and electrical systems needed to provide equal system performance and maintainability.

2.02 ELECTRICAL EQUIPMENT

- A. Electrical Disconnect Switch: Electrical disconnect switches specified for mechanical equipment shall conform to OSHA Lock-out/Tag-out requirements.
- B. All electrical equipment shall be listed as approved for its application by the Underwriters Laboratory or other testing agency approved by the State of Oregon Electrical and Elevator Board. Approval indicates agency meets testing standard requirements for electrical safety required by Oregon Revised Statutes 479.510 through 479.855 and Oregon Administrative Rules.

2.03 FIRESTOPPING

A. See Division 07.

2.04 IDENTIFICATION

A. Provide equipment identification and signage in accordance with NFPA 13.

PART 3 EXECUTION

3.01 ACCESS TO EQUIPMENT AND ACCESSORIES

- A. Install equipment with sufficient access for service. Where not conveniently accessible by other means, provide adequately sized access doors for valves, dampers, motors, belts, and all other mechanical equipment requiring access for removal or maintenance. Type, size and exact location of access doors shall be coordinated with Architect prior to work.
- B. Provide clearances for maintenance access as indicated on Drawings or as recommended by manufacturer. If access requirements shown on Drawings conflict with manufacturer's recommendations, provide larger clearance of the two.
- C. If equipment location shown on Drawings does not allow required access, notify Architect/ Engineer prior to start of work.
- D. Apply and install all items in accordance with manufacturer's written instructions. Refer conflicts between the manufacturer's instructions and the contract drawings and specifications to Architect/Engineer for resolution prior to starting work.

3.02 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

- A. Coordinate location of piping, sleeves, inserts, hangers and equipment. Locate piping, sleeves, inserts, hangers and equipment clear of windows, doors, openings, lights, electrical outlets, and other services and utilities.
- B. Equipment and Piping Support: Coordinate structural systems necessary for pipe and equipment support with pipe and equipment locations to permit proper installation.
- C. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.
- D. Minor Piping: Small diameter pipe runs from drips and drains and similar minor services are generally not shown but must be provided. Contractor is responsible to provide all such minor piping where needed.
- E. Switchgear Drip Protection: Do not install piping above electrical switchgear.
- F. Inaccessible Equipment
 - 1. Where the Owner's Authorized Representative determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost to the Owner.
 - 2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

3.03 CLEANING SYSTEMS

A. General: After all equipment and piping is installed, system shall be thoroughly cleaned. Remove all stickers and tags and clean all piping systems prior to painting.

3.04 START UP

A. The Fire Protection Contractor shall be responsible for proper operation of all systems and shall coordinate startup procedures, calibration and system checkout. System operational problems shall be diagnosed and corrected as required for system operation prior to Substantial Completion inspection.

END OF SECTION

SECTION 21 0517

SLEEVES, SLEEVE SEALS, AND ESCUTCHEONS FOR FIRE SUPPRESSION PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes sleeves, sleeve seals, escutcheons, and related materials.

1.02 ACTION SUBMITTALS

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

PART 2 PRODUCTS

2.01 SLEEVE SEAL FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. GPT; an EnPro Industries company.
 - 2. Metraflex Company (The).
- 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.

2.02 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Non-shrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.03 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated or 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.

PART 3 EXECUTION

3.01 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

3.02 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.

3.03 SLEEVE AND SLEEVE SEAL SCHEDULE

A. Use sleeve and sleeve seals for the following piping penetration applications.

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Construction Documents – Issue for Bid		FOR FIRE SUPPRESSION PIPIN	G
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- 1. Concrete Slabs on Grade
 - a. Sleeve seal fittings.

3.04 ESCUTCHEONS

- 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 piping and with OD that completely covers opening.
- C. Use one-piece, deep-pattern escutcheons for new piping where fittings would protrude from the wall and be exposed if standard escutcheons were used
- D. Escutcheons for New Piping:
 - 1. Finished Areas: One-piece, cast-brass type with polished, chrome-plated finish.
 - 2. Unfinished Areas: One-piece, cast-brass type, rough brass finish.

END OF SECTION

SECTION 21 0523

GENERAL DUTY VALVES FOR FIRE PROTECTION PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Valves for fire sprinkler system applications

1.02 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, and weld ends.
 - 3. Set valves open to minimize exposure of functional surfaces.
- 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 operating handles or stems as lifting or rigging points.
- D. Protect flanges and specialties from moisture and dirt.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

- A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" under the headings listed below and shall bear UL mark:
 - 1. Main Level: HAMV Fire Main Equipment.
 - a. Level 1: HCBZ Indicator Posts, Gate Valve.
 - b. Level 1: HLOT Valves.
 - 1) Level 3: HLUG Ball Valves, System Control.
 - 2) Level 3: HL S Butterfly Valves.
 - 3) Level 3: HMER Check Valves.
 - 4) Level 3: HMRZ Gate Valves.
 - 2. Main Level: VDGT Sprinkler System & Water Spray System Devices.
 - a. Level 1: VQGU Valves, Trim and Drain.
- B. FM Global Approved: Valves shall be listed in its "Approval Guide," under the headings listed below:
 - 1. Automated Sprinkler Systems:
 - a. Valves.
 - 1) Gate valves.
 - 2) Check valves.
 - a) Single check valves.
 - 3) Miscellaneous valves.
- C. Source Limitations for Valves: Obtain valves for each valve type from single manufacturer.
- D. ASME Compliance:
 - 1. ASME B16.1 for flanges on iron valves.
 - 2. ASME B1.20.1 for threads for threaded-end valves.
 - 3. ASME B31.9 for building services piping valves.
- E. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- F. NFPA Compliance: Comply with NFPA 24 for valves.

- G. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher as required by system pressures.
- H. Valve Sizes: Same as upstream piping unless otherwise indicated.
- I. Valve Actuator Types:
 - 1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
 - 2. Handwheel: For other than quarter-turn trim and drain valves.
 - 3. Handlever: For quarter-turn trim and drain valves NPS 2 and smaller.

2.02 TWO PIECE BALL VALVES WITH INDICATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. NIBCO INC. Victaulic
- B. Description:
 - 1. UL 1091, except with ball instead of disc and FM Global standard for indicating valves (butterfly or ball type), Class Number 1112.
 - 2. Minimum Pressure Rating: 175 psig.
 - 3. Body Design: Two piece.
 - 4. Body Material: Forged brass or bronze.
 - 5. Port Size: Full or standard.
 - 6. Seats: PTFE.
 - 7. Stem: Bronze or stainless steel.
 - 8. Ball: Chrome-plated brass.
 - 9. Actuator: Worm gear or traveling nut.
 - 10. End Connections for Valves NPS 1 through NPS 2: Threaded ends.
 - 11. End Connections for Valves NPS 2-1/2: Grooved ends.

2.03 IRON BUTTERFLY VALVES WITH INDICATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Globe Fire Sprinkler Corporation.
 - 2. Kennedy Valve Company; a division of McWane, Inc.
 - 3. NIBCO INC.
 - 4. Tyco Fire Products LP.
 - 5. Victaulic Company.
- B. Description:
 - 1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 112.
 - 2. Minimum Pressure Rating: 175 psig.
 - 3. Body Material: Cast or ductile iron with EPDM coating.
 - 4. Seat Material: EPDM.
 - 5. Stem: Stainless steel.
 - 6. Disc: Ductile iron, nickel plated.
 - 7. Actuator: Worm gear or traveling nut.
 - 8. Body Design: Grooved-end connections.

2.04 CHECK VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Globe Fire Sprinkler Corporation.
 - 2. Kennedy Valve Company; a division of McWane, Inc.
 - 3. NIBCO INC.
 - 4. Tyco Fire Products LP.
 - 5. Victaulic Company.
- B. Description:
 - 1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.

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- 2. Minimum Pressure Rating: 175 psig.
- 3. Type: Single swing check.
- 4. Body Material: Cast iron, ductile iron, or bronze.
- 5. Clapper: Bronze, ductile iron, or stainless steel.
- 6. Clapper Seat: Brass, bronze, or stainless steel.
- 7. Hinge Shaft: Bronze or stainless steel.
- 8. Hinge Spring: Stainless steel.
- 9. End Connections: Flanged, grooved, or threaded.

2.05 BRONZE OS Y GATE VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Milwaukee Valve Company.
 - 2. NIBCO INC.
- B. Description:
 - 1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS& and NRS-type gate valves).
 - 2. Minimum Pressure Rating: 175 psig.
 - 3. Body and Bonnet Material: Bronze or brass.
 - 4. Wedge: One-piece bronze or brass.
 - 5. Wedge Seat: Bronze.
 - 6. Stem: Bronze or brass.
 - 7. Packing: Non-asbestos PTFE.
 - 8. End Connections: Threaded.

2.06 IRON OS Y GATE VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Kennedy Valve Company; a division of McWane, Inc.
 - 2. Mueller Co.
 - 3. NIBCO INC.
 - 4. Victaulic Company.
- B. Description:
 - 1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS& and NRS-type gate valves).
 - 2. Minimum Pressure Rating: 175 psig.
 - 3. Body and Bonnet Material: Cast or ductile iron.
 - 4. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
 - 5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
 - 6. Stem: Brass or bronze.
 - 7. Packing: Non-asbestos PTFE.
 - 8. End Connections: Grooved.

2.07 TRIM AND DRAIN VALVES

- A. Ball Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Potter Roemer LLC.
 - e. Tyco Fire Products LP.
 - f. Victaulic Company.
 - 2. Description:
 - a. Pressure Rating: 175 psig.
 - b. Body Design: Two piece.

- c. Body Material: Forged brass or bronze.
- d. Port size: Full or standard.
- e. Seats: PTFE.
- f. Stem: Bronze or stainless steel.
- g. Ball: Chrome-plated brass.
- h. Actuator: Handlever.
- i. End Connections for Valves NPS 1 through NPS 2-1/2: Threaded ends.
- j. End Connections for Valves NPS 1-1/4 and NPS 2-1/2: Grooved ends.
- B. Angle Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.
 - b. United Brass Works, Inc.
 - 2. Description:
 - a. Pressure Rating: 175 psig.
 - b. Body Material: Brass or bronze.
 - c. Ends: Threaded.
 - d. Stem: Bronze.
 - e. Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze, or aluminum.
- C. Globe Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.
 - b. United Brass Works, Inc.
 - 2. Description:
 - a. Pressure Rating: 175 psig.
 - b. Body Material: Bronze with integral seat and screw-in bonnet.
 - c. Ends: Threaded.
 - d. Stem: Bronze.
 - e. Disc Holder and Nut: Bronze.
 - f. Disc Seat: Nitrile.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Do not attempt to repair defective valves; replace with new valves.

3.02 GENERAL REQUIREMENTS FOR VALVE INSTALLATION

- A. Comply with requirements in the following Sections for specific valve installation requirements and applications:
 - 1. Section 21 13 13 Wet-Pipe Sprinkler Systems for application of valves in wet-pipe, firesuppression sprinkler systems.
 - 2. Section 21 13 16 Dry-Pipe Sprinkler Systems for application of valves in dry-pipe, firesuppression sprinkler systems.

- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above the pipe center.
- F. Install valves in position to allow full stem movement.
- G. Install valve tags. Comply with requirements in Section 21 05 53 Identification for Fire-Suppression Piping and Equipment for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.
- H. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections.
- I. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

END OF SECTION

SECTION 21 1313

WET PIPE SPRINKLER SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes pipes, fittings, specialty valves, monitoring and control devices, and other accessories for a complete wet-pipe sprinkler system providing full coverage for areas shown on drawings.

1.02 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

1.03 ACTION SUBMITTALS

- A. General
 - Pipe and fittings: Materials List 1.
 - Specialty Valves, Sprinkler Piping Specialties, Sprinklers, Alarm Devices, Control Panels: 2. Provide catalog data. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- **Delegated Design Submittals:** Β.
 - Delegated design shall be performed and documented in accordance with NFPA 13 by a 1. Professional Fire Protection Engineer registered in Oregon.
 - Provide detailed scaled construction drawings showing fire protection piping, heads, 2. valves, fire pump, jockey pump, pump controllers, and accessories including pipe sizes, locations, elevations, slope of horizontal runs, wall and floor penetrations and connections. Include attachment details and identify system components which are located in areas of the building which are subject to freezing.
 - Submit preliminary drawings showing exposed piping and sprinkler layout to Architect a. for approval.
 - Upon approval by Architect, submit drawings to Authority Having Jurisdiction. b.
 - Upon approval by Authority Having Jurisdiction, submit final drawings with approval С stamp to Architect.
 - Provide hydraulic calculations per NFPA 13. 3.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For gualified Installer.
- B. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations.
- C. Fire-hydrant flow test report per NFPA 291.
- D. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.06 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with 1. space for minimum of 24 spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering design services. Base calculations on results of fire-hydrant flow test.
- B. Contractor shall have five years of experience in design and installation of equipment and systems similar to that specified hereunder. Contractor shall have an office within 100 miles radius of job site which can provide emergency maintenance service.
- C. The system designer shall be responsible for verifying site conditions, design requirements, and work being performed by other trades as related to the suppression system design. Design shall accommodate work being performed by other trades. Contractor shall identify areas of the building which will be subject to freezing.
- D. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Sprinkler system sizing, arrangement, equipment, specialties, accessories, installation, and testing shall comply with NFPA 13.
- B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- C. Design Requirements:
 - 1. Contractor shall obtain water service test data including static pressure and residual pressure/water flow available at the project site.
 - 2. Sprinkler system design shall be approved by authorities having jurisdiction (AHJ).
 - 3. Margin of Safety for Available Water Flow: 10%.
 - 4. Margin of Safety for Available Water Pressure: 10 psi.
 - 5. Sprinkler Occupancy Hazard Classifications as indicated on fire zoning plans:
 - a. Classrooms: Light Hazard
 - b. Building Service Areas: Ordinary Hazard, Group 1.
 - c. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
 - d. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
 - e. Office and Public Areas: Light Hazard.
 - 6. Provide minimum density as required by NFPA 13.
 - 7. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions according to NFPA 13 and ASCE/SEI 7.

2.02 STEEL PIPE AND FITTINGS

- A. Standard-Weight, Schedule 40, Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Schedule 10, Black-Steel Pipe: ASTM A 135/A 135M or ASTM A 795/A 795M, Schedule 10 in NPS 2and smaller.
- C. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- D. Uncoated-Steel Couplings: ASTM A 865/A 865M, threaded.
- E. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- F. Malleable- or Ductile-Iron Unions: UL 860.
- G. Cast-Iron Flanges: ASME 16.1, Class 125.
- H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
 - 1. Metal, Pipe-Flange Bolts and Nuts: Carbon steel unless otherwise indicated.
- I. Grooved-Joint, Steel-Pipe Appurtenances:
 - 1. Pressure Rating: 175-psig minimum.

- 2. Painted Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.
- 3. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.03 DUCTILE IRON PIPE AND FITTINGS

- A. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-groove ends.
- B. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 1. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- C. Flanges: ASME B16.1, Class 125, cast iron.

2.04 SPECIALTY VALVES

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- B. Pressure Rating:
 - 1. Standard-Pressure Piping Specialty Valves: 175-psigminimum.
- C. Body Material: Cast or ductile iron.
- D. Size: Same as connected piping.
- E. End Connections: Flanged or grooved.
- F. Alarm Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc. (The)
 - b. Tyco Fire Products LP
 - c. Victaulic Company
 - 2. Standard: UL 193
 - 3. Design: For horizontal or vertical installation
 - 4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gauges, retarding chamber, and fill-line attachment with strainer.
 - 5. Drip Cup Assembly: Pipe drain with check valve to main drain piping.
 - 6. 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.

2.05 SPRINKLER PIPING SPECIALTIES

- A. Branch Outlet Fittings:
 - 1. Standard: UL 213.
 - 2. Pressure Rating: 175-psig minimum.
 - 3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
 - 4. Type: Mechanical-tee and -cross fittings.
 - 5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
 - 6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
 - 7. Branch Outlets: Grooved, plain-end pipe, or threaded.
- B. Flow Detection and Test Assemblies:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc. (The).
 - b. Tyco Fire Products LP.
 - 2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
 - 3. Pressure Rating: 175-psig minimum.
 - 4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.

- 5. Size: Same as connected piping.
- 6. Inlet and Outlet: Threaded or grooved.
- C. Sprinkler Inspector's Test Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Tyco Fire Products LP.
 - b. Victaulic Company.
 - 2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
 - 3. Pressure Rating: 175-psig minimum.
 - 4. Body Material: Cast- or ductile-iron housing with sight glass.
 - 5. Size: Same as connected piping.
 - 6. Inlet and Outlet: Threaded.
- D. Adjustable Drop Nipples:
 - 1. Standard: UL 1474.
 - 2. Pressure Rating: 250-psig minimum.
 - 3. Body Material: Steel pipe with EPDM-rubber O-ring seals.
 - 4. Size: Same as connected piping.
 - 5. Length: Adjustable.
 - 6. Inlet and Outlet: Threaded.
- E. Flexible Sprinkler Hose Fittings:
 - 1. Standard: UL 2443.
 - 2. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
 - 3. Pressure Rating: 175-psig minimum.
 - 4. Size: Same as connected piping, for sprinkler.

2.06 SPRINKLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Reliable Automatic Sprinkler Co., Inc. (The).
 - 2. Tyco Fire Products LP.
 - 3. Victaulic Company.
 - 4. Viking Corporation
- B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- C. Pressure Rating for Automatic Sprinklers: 175-psig minimum.
- D. Automatic Sprinklers with Heat-Responsive Element:
 - 1. Quick Response Applications: UL 2443.
 - 2. Nonresidential Applications: UL 199.
 - 3. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- E. Sprinkler Finishes: Chrome plated bronze and painted.
- F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
 - 1. Ceiling Mounting: Chrome-plated steel, one-piece, flat.
 - 2. Sidewall Mounting: Chrome-plated steel, one-piece, flat.
- G. Sprinkler Guards:
 - 1. Standard: UL 199.
 - 2. Type: Wire cage with fastening device for attaching to sprinkler.

2.07 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

- B. Water-Flow Indicators:
 - Standard: UL 346. 1.
 - 2. Water-Flow Detector: Electrically supervised.
 - Components: Two single-pole, double-throw circuit switches for isolated alarm and 3. auxiliary contacts. 7 A. 125-V ac and 0.25 A. 24-V dc; complete with factory-set, fieldadjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
 - 4. Type: Paddle operated.
 - 5. Pressure Rating: 250 psig.
 - Design Installation: Horizontal or vertical. 6.
- C. Pressure Switches:
 - Standard: UL 346. 1.
 - Type: Electrically supervised water-flow switch with retard feature. 2.
 - Components: Single-pole, double-throw switch with normally closed contacts. 3.
 - Design Operation: Rising pressure signals water flow. 4.
- D. Valve Supervisory Switches:
 - 1. Standard: UL 346.
 - 2. Type: Electrically supervised.
 - Components: Single-pole, double-throw switch with normally closed contacts. 3.
 - Design: Signals that controlled value is in other than fully open position. 4.
 - Electrical Components, Devices, and Accessories: Listed and labeled as defined in 5. NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.08 PRESSURE GAUGES

- A. Standard: UL 393.
- B. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- C. Pressure Gauge Range: 0- to 250-psig minimum.
- D. Label: Include "WATER" label on dial face.

PART 3 EXECUTION

3.01 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.02 SERVICE ENTRANCE PIPING

- A. Provide service water piping to within 5 feet of the building line. Coordinate with civil drawings for connection location.
- B. Install shutoff valve, pressure gauge, drain, and other accessories indicated at water-service piping building entrance.

3.03 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
 - Deviations from approved working plans for piping require written approval from 1. authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
 - Coordinate layout and installation of sprinklers with other construction that penetrates 2. ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.
- C. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.

- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2-inch and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve. Size and locate according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to spill over floor drain or to outside building.
- K. Install alarm devices in piping systems.
 - 1. Electrical Power Connections:
 - a. Connect field electrical power source to each separate device requiring field electrical power. Coordinate termination point and connection type with Installer.
 - b. Wiring Method: Comply with requirements in Section 26 05 19 Low-Voltage Electrical Power Conductors and Cables.
 - c. Provide nameplate for each electrical connection indicating electrical equipment designation and circuit number feeding connection. Nameplate shall comply with requirements in Division 28 and NFPA 13.
- L. Install hangers and supports and seismic restraint for sprinkler system piping according to NFPA 13.
- M. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gauges with connection not less than NPS 1/4 and with softmetal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal and install where they are not subject to freezing.
- N. Fill sprinkler system piping with water.
- O. Install sleeve seals for piping penetrations of exterior concrete walls and slabs. Comply with requirements for escutcheons specified in Section 21 05 17 Sleeves, Sleeve Seals, and Escutcheons for Fire-Suppression Piping.
- P. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 21 05 17 Sleeves, Sleeve Seals, and Escutcheons for Fire-Suppression Piping.

3.04 OINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2-inch and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.05 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
 - 1. Install valves in vertical position for proper direction of flow, in main supply to system.
 - 2. Install alarm valves with bypass check valve and retarding chamber drain-line connection.

3.06 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.
- B. Install dry-type sprinklers with water supply from heated space. Do not install wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.07 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26.

3.08 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Coordinate with fire-alarm tests. Operate as required.
 - 6. Verify that equipment hose threads are same as local fire department equipment.
- B. Prepare test and inspection reports.

3.09 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.10 PIPING SCHEDULE

- A. Underground Piping: Ductile iron pipe and fittings.
- B. Above-grade Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.
- C. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- D. Standard-pressure, wet-pipe sprinkler system, NPS 2 inches and smaller, shall be the following:
 - 1. Standard-weight, Schedule 40 with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
- E. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2-inch and larger shall be one of the following:
 - 1. Schedule 10, black-steel pipe with roll-grooved ends: uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.11 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
 - 1. Wall Mounting: Sidewall sprinklers.
 - 2. Light and Ordinary hazard fire sprinklers: Quick response.
 - 3. Provide sprinkler guards on sprinkler heads in server room.
 - 4. Provide sprinkler guards on sprinkler heads in the gym room.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
 - 1. Upright Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view.

END OF SECTION

SECTION 21 1316

DRY PIPE SPRINKLER SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes pipes, fittings, specialty valves, monitoring and control devices, and other accessories for a complete dry pipe sprinkler system providing full coverage for areas shown on drawings.

1.02 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Dry-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum Related Requirements:

1.03 ACTION SUBMITTALS

- A. General
 - 1. Pipe and Fittings: Materials List
 - 2. Specialty Valves, Sprinkler Piping Specialties, Sprinklers, Alarm Devices, Control Panels: Provide catalog data. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Delegated-Design Submittal:
 - 1. Delegated design shall be performed and documented in accordance with NFPA 13 by a Professional Fire Protection Engineer registered in Oregon.
 - 2. Provide detailed scaled construction drawings showing fire protection piping, heads, valves, and accessories including pipe sizes, locations, elevations, slope of horizontal runs, wall and floor penetrations and connections. Include attachment details and identify system components which are located in areas of the building which are subject to freezing.
 - a. Submit preliminary drawings showing exposed piping and sprinkler layout to Architect for approval.
 - b. Upon approval by Architect, submit drawings to Authority Having Jurisdiction.
 - c. Upon approval by Authority Having Jurisdiction, submit final drawings with approval stamp to Architect.
 - 3. Provide hydraulic calculations per NFPA 13.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification data: For qualified installer.
- B. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- C. Fire-hydrant flow test report.
- D. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For dry-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
- B. Contractor shall have five years of experience in design and installation of equipment and systems similar to that specified hereunder. Contractor shall have an office within 100 miles radius of job site which can provide emergency maintenance service.

C. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.

PART 2 PRODUCTS

2.01 SYSTEM DESCRIPTIONS

A. Double-Interlock Pre-action Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of a fire-detection system, located in same area as sprinklers, will activate the normally closed solenoid but will not open the pre-action valve. Activation of a sprinkler head will not permit water to flow into sprinkler piping. Activation of both the normally closed solenoid valve and automatic sprinkler is required to cause the pre-action valve to open, permitting water to flow into sprinkler piping, and water will then discharge from opened sprinkler.

2.02 PERFORMANCE REQUIREMENTS

- A. Sprinkler system sizing, arrangement, equipment, specialties, accessories, installation, and testing shall comply with NFPA 13.
- B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- C. Design Requirements:
 - 1. Contractor shall obtain water service test data including static pressure and residual pressure/water flow available at the project site.
 - 2. Sprinkler system design shall be approved by authorities having jurisdiction.
- D. Sprinkler Occupancy Hazard Classifications:
 - 1. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
 - 2. Provide minimum density as required by NFPA 13.
 - 3. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

2.03 STEEL PIPE AND FITTINGS

- A. Standard-Weight, Schedule 40, Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- C. Uncoated-Steel Couplings: ASTM A 865/A 865M, threaded.
- D. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- E. Malleable- or Ductile-Iron Unions: UL 860.
- F. Cast-Iron Flanges: ASME 16.1, Class 125.
- G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
 - 1. Metal, Pipe-Flange Bolts and Nuts: Carbon steel unless otherwise indicated.
- H. Grooved-Joint, Steel-Pope Appurtenances:
 - 1. Pressure Rating: 175-psig minimum
 - 2. Painted Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.
 - 3. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.04 SPECIALTY VALVES

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- B. Pressure Rating:
 - 1. Standard-Pressure Piping Specialty Valves: 175-psig minimum.
- C. Body Material: Cast or ductile iron.
- D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

2.05 PREACTION SYSTEM VALVE ASSEMBLIES

- A. Pre-action Valve
 - 1. Basis of Design: Tyco DV-5
 - 2. The packaged valve assembly includes but is not limited to pre-action deluge valve, check valve, valve trim, pressure alarm switch, and electric actuation for a complete double interlock pre-action system assembly.
 - 3. Include trim sets for alarm-test bypass, drain, electrical water-flow alarm switch, pressure gauges, drip cup assembly piped without valves and separate from main drain line, and fill-line attachment with strainer.
 - 4. Dry, Pilot-Line Trim Set: Include dry, pilot-line actuator; air- and water-pressure gauges; low-air-pressure warning switch; air relief valve; and actuation device. Dry, pilot-line actuator includes cast-iron, operated, diaphragm-type valve with resilient facing plate, resilient diaphragm, and replaceable bronze seat. Valve includes threaded water and air inlets and water outlet. Loss of air pressure on dry, pilot-line side allows pilot-line actuator to open and causes deluge valve to open immediately.
 - 5. Sight flow gauge on main drain.
 - 6. Double interlock electric/electric actuation.
 - 7. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.
 - 8. Pressure Gauges
 - a. Standard: UL 393
 - b. Dial Size: 3-1/2 to 4-1/2-inch diameter.
 - c. Pressure Gauge Range: 0- to 250-psig minimum.
 - 9. Label: Include "WATER" label on dial face.
- B. Automatic (Ball Drip) Drain Valves:
 - 1. Standard: UL 1726.
 - 2. Pressure Rating: 175-psig minimum.
 - 3. Type: Automatic draining, ball check
 - 4. Size: NPS 3/4.
 - 5. End Connections: Threaded

2.06 SPRINKLER PIPING SPECIALTIES

- A. Air Compressor:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. General Air Products, Inc.
 - b. Viking Corporation.
 - 2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
 - 3. Tank mounted air compressor for dry pipe sprinkler systems.
 - 4. Motor Horsepower: Fractional.
 - 5. Power: 120-Vac, 60Hz, single-phase.
- B. General Requirements for Dry-Pipe System Fittings: UL listed for dry-pipe service.
- C. Branch Outlet Fittings:
 - 1. Standard: UL 213.
 - 2. Pressure Rating: 175-psig minimum.
 - 3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
 - 4. Type: Mechanical-tee and -cross fittings.
 - 5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
 - 6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
 - 7. Branch Outlets: Grooved, plain-end pipe, or threaded.

- D. Flow Detection and Test Assemblies:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc. (The).
 - b. Tyco Fire Products LP.
 - 2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
 - 3. Pressure Rating: 175-psig minimum.
 - 4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
 - 5. Size: Same as connected piping.
 - 6. Inlet and Outlet: Threaded.
 - 7. Water-Flow Indicators
 - a. Standard: UL 346.
 - b. Water-Floe Detector: Electrically supervised.
 - c. Components: Two single-pole, double throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
 - d. Type: Paddle operated
 - e. Pressure Rating: 250 psig.
 - f. Design Installation: Horizontal or vertical.
- E. Sprinkler Inspector's Test Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Tyco Fire Products LP.
 - b. Victaulic Company.
 - 2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
 - 3. Pressure Rating: 175-psig minimum.
 - 4. Body Material: Cast- or ductile-iron housing with sight glass.
 - 5. Size: Same as connected piping.
 - 6. Inlet and Outlet: Threaded
- F. Adjustable Drop Nipples:
 - 1. Standard: UL 1474.
 - 2. Pressure Rating: 250-psig minimum.
 - 3. Body Material: Steel pipe with EPDM O-ring seals.
 - 4. Size: Same as connected piping.
 - 5. Length: Adjustable.
 - 6. Inlet and Outlet: Threaded.

2.07 SPRINKLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Reliable Automatic Sprinkler Co., Inc. (The).
 - 2. Tyco Fire Products LP.
 - 3. Victaulic Company.
 - 4. Viking corporation.
- B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- C. Pressure Rating for Automatic Sprinklers: 175-psig minimum.
- D. Automatic Sprinklers with Heat-Responsive Element:
 - 1. Nonresidential Applications: UL 199.
 - 2. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

- E. Sprinkler Finishes: Chrome-plated bronze and painted.
- F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
 - 1. Sidewall Mounting: Chrome-plated steel, one piece, flat.
- G. Sprinkler Guards:
 - 1. Standard: UL 199.
 - 2. Type: Wire cage with fastening device for attaching to sprinkler.

2.08 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Water-Flow Indicators:
 - 1. Standard: UL 346.
 - 2. Water-Flow Detector: Electrically supervised.
 - 3. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
 - 4. Type: Paddle operated.
 - 5. Pressure Rating: 250 psig.
 - 6. Design Installation: Horizontal or vertical.
- C. Pressure Switches:
 - 1. Standard: UL 346.
 - 2. Type: Electrically supervised water-flow switch with retard feature.
 - 3. Components: Single-pole, double-throw switch with normally closed contacts.
 - 4. Design Operation: Rising pressure signals water flow.
- D. Valve Supervisory Switches:
 - 1. Standard: UL 346.
 - 2. Type: Electrically supervised.
 - 3. Components: Single-pole, double-throw switch with normally closed contacts.
 - 4. Design: Signals that controlled valve is in other than fully open position.
 - 5. 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

2.09 PRESSURE GAUGES

- A. Standard: UL 393.
- B. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- C. Pressure Gauge Range: 0- to 250-psig minimum.
- D. Label: Include "WATER" label on dial face.
- E. Air System Piping Gauge: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

PART 3 EXECUTION

3.01 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.02 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
- B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.
- C. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.

- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes
- E. Install unions adjacent to each valve in pipes NPS 2and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install automatic (ball drip) drain valves to drain piping between fire department connections and check valves. Drain to floor drain or to outside building.
- K. Connect compressed-air supply to dry-pipe sprinkler piping.
- L. Connect air compressor to the following piping and wiring:
 - 1. Pressure gauges and controls.
 - 2. Electrical power system.
 - 3. Fire-alarm devices, including low-pressure alarm.
- M. Install alarm devices in piping systems.
 - 1. Electrical Power Connections:
 - a. Connect field electrical power source to each separate device requiring field electrical power. Coordinate termination point and connection type with Installer.
 - b. Wiring Method: Comply with requirements in Section 26 05 19 Low-Voltage Electrical Power Conductors and Cables.
 - c. Provide nameplate for each electrical connection indicating electrical equipment designation and circuit number feeding connection. Nameplate shall comply with requirements in Division 28 and NFPA 13.
- N. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in NFPA 13.
- O. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gauges with connection not less than NPS ¼ and with softmetal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal and install where they are not subject to freezing.
- P. Drain dry-pipe sprinkler piping.
- Q. Pressurize and check dry-pipe sprinkler system piping and air-pressure maintenance devices air compressors.
- R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 21 05 17 – Sleeves, Sleeve Seals, and Escutcheons for Fire-Suppression Piping.

3.03 OINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
- I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.04 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
 - 1. Install valves in vertical position for proper direction of flow, in main supply to system.
 - 2. Install dry-pipe and deluge valves with trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.
 - 3. Install air compressor and compressed-air-supply piping.

3.05 SPRINKLER INSTALLATION

A. Install sprinklers with water supply from heated space. Do not install pendent or sidewall sprinklers in areas subject to freezing.

3.06 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13. Coordinate with Division 22 and 23. Match manufacturer, type, and style of identification used.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26.

3.07 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Start and run air compressors.
 - 6. Coordinate with fire-alarm tests. Operate as required
 - 7. Coordinate with fire-pump tests. Operate as required.

- 8. Verify that equipment hose threads are same as local fire department equipment.
- B. Sprinkler piping system will be considered defective if it does not pass tests and inspections..
- C. Prepare test and inspection reports.

3.08 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.09 DEMONSTRATION

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

3.10 PIPING SCHEDULE

- A. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- B. Standard-pressure, dry-pipe sprinkler system, NPS 2 and smaller, shall be the following:
 - 1. Schedule 40, black steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
- C. Standard-pressure, dry-pipe sprinkler system, NPS 2-1/2 to NPS 6, shall be the following:
 - 1. Schedule 40, black steel pipe with cut-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.11 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
 1. Wall Mounting: Sidewall sprinklers.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
 - Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION
GENERAL PLUMBING PROVISIONS

PART 1 GENERAL

1.01 CONTRACT DOCUMENTS

- A. General plumbing provisions apply to all work performed in Division 22.
- B. The Contract Documents are complementary. What is required by any one, as affects this Division, shall be as binding as if repeated herein.
- C. Separation of this Division from other Contract Documents shall not be construed as segregation of the Work.
- D. Location of equipment on Drawings is approximate. Plan exact location with respect to site measurements and work of other trades prior to starting work. If measurements differ slightly, modify work. If measurements differ substantially, notify Architect/Engineer and Owner's Authorized Representative prior to fabrication.
- E. Make minor changes in equipment connections and equipment locations as directed or required before rough-in without extra cost.
- F. For products specified by listing one or more manufacturers, followed by "Similar to" and one manufacture's model number, the following requirements apply:
 - 1. Approval of each listed manufacturer is contingent upon that manufacturer having a product which meets the specification, fits in the available space, and is comparable to the listed model.
 - 2. Electrical requirements, duct connections, pipe connections, and space requirements indicated on the Drawings are based on the listed model and may not be suitable for all manufacturers listed. Provide revisions required to accommodate the model actually furnished.
- G. For product specified by listing one or more manufacturers, followed by a model number for each manufacturer, the following requirements apply:
 - 1. Provide one of the listed model numbers or an approved substitution.
 - 2. Electrical requirements, duct connections, pipe connections, and space requirements indicated on the Drawings are based on one of the listed models and may not be suitable for all models listed. Provide revisions required to accommodate the model actually furnished.

1.02 DEFINITIONS

- A. Authority Having Jurisdiction (AHJ): The governmental agency or sub-agency which regulates the construction process.
- B. Owner's Authorized Representative (OAR): Owner's representative with authority to act on Owner's behalf.
- C. Provide: Equivalent to "Furnish and Install."

1.03 COORDINATION

- A. Check drawings of other trades to avert possible installation conflicts. Should major changes from original drawings be necessary to resolve such conflicts, notify Architect/Engineer and secure written approval and agreement on necessary adjustments before start of work.
- B. Architectural drawings govern all other drawings. Consult in detail the door swings, counter heights and similar items affecting work before rough-in.
- C. Coordinate identification systems with other trades. All plumbing and mechanical systems shall use identical piping, valve, and equipment identification and regulatory signage.

1.04 SUBMITTALS AND SHOP DRAWINGS

- A. See Division 01.
- B. Action Submittal Content

- 1. Action submittal information not expressly required by the specifications will not be reviewed.
- 2. Action submittal information shall be provided in sufficient detail to establish conformance with specified requirements. Where submitted literature includes multiple models, features, or options, the specific models, features, or options proposed shall be clearly indicated. Where a brief inspection shows that product data is not complete, the submittal will be rejected without review.
- 3. Action submittal data shall be clear, concise, legible, and relevant. Where data is not properly organized and contains significant information that is not relevant, the submittal will be rejected without review.
- 4. Action submittal requirements will be listed in individual specification sections. The following definitions apply.
 - a. Materials List: Provide tabular list of materials including specification reference, specification product name, manufacturer, model/part number, and size and/or quantity where appropriate. Do not include supplemental data, except where specifically requested.
 - b. Catalog data: Manufacturer's standard product cut sheet.
 - c. Product Data: Detailed data including dimensions, weight, materials of construction, connections, and all other information needed to confirm that the product conforms to all requirements listed in the individual specification section.
 - d. Performance Data: Capacity, input, output, flow, etc. as required to confirm that the product meets the performance requirements scheduled in the Specifications or on the Drawings.
 - e. Wiring Diagrams: Power and control wiring diagrams.
 - f. Shop Drawings: Construction drawings of items manufactured specifically for this project including dimensions, construction details, weights, and additional information to identify the physical features of the system or piece of equipment.
 - g. Installation Instructions
 - h. Special Requirements Listed: Additional requirements indicated in individual specification sections.
- C. Delegated Design
 - 1. Delegated work will include but is not limited to the following.
 - a. Section 22 05 48 Vibration and Seismic Control for Plumbing Piping and Equipment.
 - 2. 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.
 - a. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.
 - 3. Delete requirement if not applicable
 - 4. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file, 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.
 - a. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.05 QUALITY ASSURANCE

- A. All materials and equipment provided hereunder shall be installed and started in complete conformance with the manufacturer's recommendations.
- B. Asbestos products or equipment or materials containing asbestos shall not be used.

1.06 DESIGN REQUIREMENTS

A. Equipment and systems provided hereunder shall be rated to provide performance specified and scheduled on Drawings at the elevation of the project site.

B. Materials and equipment provided hereunder shall be rated for the service conditions of the system to which they are connected including but not limited to temperature, pressure, and humidity.

1.07 CODES AND STANDARDS

- A. Applicable codes and standards shall determine minimum requirements for materials, methods, and labor practices not otherwise stated herein.
- B. Work shall comply with the Americans with Disabilities Act (ADA).

1.08 TEMPORARY SERVICES

- A. Provide in accordance with Division 01 as required for completion of work. Provide additional filters as required to keep areas clean during construction
- B. Maintain existing systems operational. Owner will be responsible to operate and maintain existing equipment during the course of the project. However, any damage to existing equipment resulting directly from work under this Contract shall be repaired by the Contractor at no expense to Owner.

1.09 OPERATIONS AND MAINTENANCE MANUALS

- A. Provide manuals as noted in Division 01, clearly indexed and bookmarked for each item or product. Include a directory of all subcontractors and maintenance contractors with names, addresses, and telephone numbers, indicating the area of responsibility for each. Index tabs shall match submittal schedule and include any additional information required for operations and maintenance, whether in submitted schedule or not.
- B. Maintenance instructions shall indicate routine-type work with step-by-step instructions that should be performed to ensure long life and proper operations. Recommended frequency of performance shall also be included.
- C. Provide copy of approved submittal for each product included in manual
- D. Provide printed copy and electronic configuration files for all packaged equipment control systems furnished with equipment.
- E. Mark the model actually provided where the literature covers more than one model. Include four copies of all submittal data corrected to "as-built" conditions within the manual.
- F. Provide a composite summary table indicating each item of equipment listed in the operations and maintenance manual and its required maintenance and time period. This summary table shall be the first section in the O&M manual.
- G. Manual Content: Manuals shall contain complete information for each item of plumbing electrical or other operating equipment. Include as applicable:
 - 1. Manufacturer's instructions for installation, startup, operation, inspection, and maintenance
 - 2. Lubrication schedules
 - 3. Performance capacity
 - 4. Catalog data sheets
 - 5. Parts list
 - 6. Maintenance schedules

1.10 RECORD DRAWINGS

A. Provide record "as-built" drawings in accordance with Division 1 requirements. Show all deviations from contract drawings and location of underground lines by accurate dimensions from building lines. Show depth of all stub outs and underground lines. Dimension all concealed piping from column grids or building lines. Transfer all information to one hard copy of drawings at completion of project. Alternately, provide electronically using .pdf markup of contract drawings.

1.11 DEMONSTRATION

- A. General: After installation is complete, demonstrate to Engineer and Owner's Authorized Representative satisfaction as being complete and operational and entirely in conformance with Contract Documents.
- B. Preparation: Prior to demonstration, submit check-off list indicating completeness of submittals

and certificates of compliance for review to Owner's Authorized Representative. Operate completed system for one week. Verify that control verification is complete and verification report has been approved by Architect/Engineer.

C. Arrange for demonstration with Owner, Engineer, required factory technicians, and installer at least one week in advance of demonstration.

1.12 TRAINING

- A. Instruct Owner in proper operation and maintenance of equipment and systems. Instruction shall generally include topics listed in manufacturer's operations and maintenance manual. Operator instructions shall cover all aspects of manual, automatic, and safety controls. Contractor shall also instruct the Owner in the general configuration of systems and location of equipment and components.
- B. Furnish competent qualified technicians knowledgeable in the plumbing systems and equipment provided for this project for a minimum of 2-hours on-site to instruct Owner in operation and maintenance of systems and equipment. This figure does not include additional training noted under individual specification sections. Contractor shall keep a log of this instruction including date, times, subjects, and those present and shall present such log when requested by Engineer. Contractor shall coordinate training with Owner's Project Manager and provide a schedule for training minimum two-weeks prior to Substantial Completion. All training shall be complete 30-days after Substantial Completion.
- C. Contractor shall furnish training by equipment manufacturers in addition to training described in this section where specifically listed in other sections. Contractor shall schedule training with Owner's Project Manager minimum 48-hours prior to training session. Equipment shall be fully operational prior to scheduling training session. Manufacturer's field start-up, adjustment, and service will not fulfill manufacturer's training requirement.

PART 2 PRODUCTS

2.01 PRODUCTS AND MATERIALS

- A. All materials employed in permanent construction shall be new, full weight, in first class condition, and suitable for space provided. All similar equipment and materials shall be of one manufacturer.
- B. Equipment used as the basis of design is scheduled on drawings or designated in product specifications. If Contractor chooses to use equipment that is not the basis of design, Contractor is responsible for all re-design and construction costs associated with variations in arrangement, dimension, or capacity. Such work may include, but is not limited to, changes to facility structure or dimensions and revisions to associated plumbing and electrical systems needed to provide equal system performance and maintainability.

2.02 ELECTRICAL EQUIPMENT

- A. Electrical Disconnect Switch: Electrical disconnect switches specified for plumbing equipment shall conform to OSHA Lock-out/Tag-out requirements.
- B. All electrical equipment shall be listed as approved for its application by the Underwriters Laboratory or other testing agency approved by the State of Oregon Electrical and Elevator Board. Approval indicates agency meets testing standard requirements for electrical safety required by Oregon Revised Statutes 479.510 through 479.855 and Oregon Administrative Rules.
- C. Enclosure: Provide the following electrical equipment enclosure types unless otherwise noted.
 - 1. NEMA 1: Dry, enclosed locations where the ambient temperature will not be outside of the VFD temperature ratings.
 - 2. NEMA 12: Enclosed mechanical spaces equipped with floor drains where dripping or splashing may occur and where the ambient temperature will not be outside of the VFD temperature ratings.
 - 3. NEMA 3R: Swimming pool mechanical rooms and other mechanical spaces where more sustained water spray is possible
 - 4. NEMA 3R with Temperature Control: Outdoors or in unconditioned spaces where ambient

temperatures will be outside of the VFD temperature ratings.

5. Enclosure will be provided with a ventilation fan and heater capable of maintaining enclosure temperature within the manufacturer's recommended range. Drive and enclosure shall be a single, UL-listed assembly with single point electrical connections.

2.03 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Acceptable Manufacturers: J.L. Industries, Karp Associates, Inc., Meadowcraft, Inc., Milcor Div.; Inryco, Inc., or Nystrom, Inc.
- B. Application: Match access door to wall or roof assembly fire rating.
- C. Access Door Assembly: Continuous welded steel construction unless otherwise indicated. Grind exposed welds smooth and flush with adjacent surfaces. Provide anchors and attachments necessary for installation indicated.
 - 1. Frames: 16 gage steel; provide flange type necessary for the installation required.
 - 2. Stainless Steel Frames and Flush Panel Doors: 14 gage stainless steel, No. 4. satin finish; concealed spring hinges or concealed piano hinge set to open 175 degrees.
 - 3. Flush Doors: 14-gage sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees
 - 4. Lock: Screwdriver-operated cam locks, number required to hold door flush when closed.
 - 5. Ceiling Doors: Recessed door panel depth necessary to finish ceiling insert and install flush to adjacent finish ceiling. Reinforced 18 gage sheet steel face. Provide access sleeves for locking devices. Size: As necessary for efficient access, but not less than 24 by 24 inches. Obtain Architect's acceptance of manufacturer's standard size units which vary from sizes indicated.
- D. Fire Rated Units: Comply with NFPA 80, provide UL listed and labeled units having performance level required with insulated flush panel door, continuous piano hinge and self-closing mechanism for rated assemblies in sizes and configuration required.
 - 1. Vertical Doors: NFPA 252 or UL 10B.
 - 2. Horizontal Doors: ASTM E 119 or UL 263.
- E. Shop Applied Coating: Corrosion resistant prime paint compatible with field applied finish specified in Division 09.
- F. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 tested according to the following test method:
 - 1. NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically.
 - 2. NFPA 288 for fire-rated access door assemblies installed horizontally.

2.04 SPECIAL TOOLS AND LUBRICANTS

A. Furnish and turn over to Owner, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.

PART 3 EXECUTION

3.01 ACCESS TO EQUIPMENT AND ACCESSORIES

- A. Install equipment with sufficient access for service. Where not conveniently accessible by other means, provide adequately sized access doors for valves, motors, belts, and all other plumbing equipment requiring access for removal or maintenance. Type, size and exact location of access doors shall be coordinated with Architect prior to work.
- B. Provide clearances for maintenance access as indicated on Drawings or as recommended by manufacturer. If access requirements shown on Drawings conflict with manufacturer's recommendations, provide larger clearance of the two.
- C. If equipment location shown on Drawings does not allow required access, notify Architect/ Engineer prior to start of work.
- D. Apply and install all items in accordance with manufacturer's written instructions. Refer conflicts between the manufacturer's instructions and the contract drawings and specifications to Architect/Engineer for resolution prior to starting work.

- E. Provide access doors as required for access to plumbing equipment. Doors required for access are not necessarily shown on Drawings. Consult with Architect for direction on placement of required doors not shown on Drawings.
 - 1. Comply with manufacturer's instructions for installation of access doors. Provide all necessary support and supplemental framing for assembly where the access doors are required. Set accurately in position, plumb, level, and flush to adjacent finish surfaces; and secure to support.

3.02 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

- A. Coordinate location of piping, sleeves, inserts, hangers, ductwork and equipment. Locate piping, sleeves, inserts, hangers, ductwork and equipment clear of windows, doors, openings, lights, electrical outlets, and other services and utilities. Follow manufacturer's published recommendations for installation methods not otherwise specified.
- B. Equipment and Piping Support: Coordinate structural systems necessary for pipe and equipment support with pipe and equipment locations to permit proper installation.
- C. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.
- D. Minor Piping: Small diameter pipe runs from drips and drains, water cooling, and similar minor services are generally not shown but must be provided. Contractor is responsible to provide all such minor piping where needed to maintain mechanical spaces clean and dry and to allow full equipment function and maintenance.
- E. Interconnection of Controls and Instruments: Generally not shown but must be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments and computer workstations. Comply with NFPA-70.
- F. Switchgear Drip Protection: Do not install piping above electrical switchgear.
- G. Inaccessible Equipment
 - 1. Where the Owner's Authorized Representative determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost to the Owner.
 - 2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

3.03 PLUMBING SYSTEMS FIRESTOPPING

- A. Do not cover firestop installations until the examined by the Authority Having Jurisdiction, if required.
- B. Install firestopping in accordance with manufacturer's recommendations and conditions of product UL listing.

3.04 CLEANING SYSTEMS

A. General: After all equipment and pipes are installed, system shall be thoroughly cleaned. Remove all stickers and tags from equipment or fixtures. Clean all piping systems prior to installation of insulation or painting.

3.05 START UP

A. The Plumbing Contractor shall be responsible for proper operation of all systems and shall coordinate startup procedures, calibration and system checkout. System operational problems shall be diagnosed and corrected as required for system operation prior to Substantial Completion inspection.

COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, squirrel-cage induction and electrically commutated 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.

1.02 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

2.02 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40°C and at altitude of 3,300 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.

2.03 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Rotor: Random-wound, squirrel cage.
- E. Bearings: Re-greaseable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- F. Temperature Rise: Match insulation rating.
- G. Insulation: Class F.
- H. Code Letter Designation:
 - 1. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- I. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.
- J. Enclosure Type: Provide open drip proof enclosure, except provide totally enclosed fan cooled enclosure for the applications listed below, or as expressly specified elsewhere, or as indicated on Drawings.
 - 1. Outdoor applications including roof exhaust fans, cooling towers, and similar equipment.
 - 2. Fan motors mounted in an unfiltered air stream.
 - 3. Motors on equipment related to life safety including fire pumps and similar equipment.
 - 4. Motors 10 HP and larger.
- K. Additional Requirements for Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

- 1. Inverter Duty as defined in NEMA MG 1 with Class F temperature rise, Class H insulation.
- 2. 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.
- 3. Speed Ratio:
 - a. Constant load applications: 4:1.
 - b. Variable torque applications: 10:1.
- 4. Bearing Protection Ring: For motors controlled by variable frequency drives, provide maintenance free, conductive microfiber, shaft grounding ring with a minimum of two rows of circumferential microfibers to discharge electrical shaft currents within the motor and/or its bearings. AEGIS SGR or approved equal.

2.04 SINGLE PHASE INDUCTION 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: Pre-lubricated, 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

3.01 EXAMINATION

A. Verify motor mounts are compatible with motor frame.

3.02 INSTALLATION

A. Motors Used with Variable Frequency Controllers: Arrange location of motor, variable frequency controller and electrical wiring to ensure the distance from motor to inverter does not exceed manufacturer recommended maximum length.

3.03 APPLICATION

- A. Induction Motors
 - 1. Motors Less Than 1/2 HP: Single-Phase
 - 2. Motors 1/2 HP and larger: Polyphase.

MOTOR CONTROL DEVICES FOR PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manual Motor Controller

1.02 DESIGN REQUIREMENTS

- A. Provide motor protection switches of the appropriate NEMA size. For units not using NEMA rating, use equivalent NEMA size.
- B. Provide motor protection switches in the proper enclosure as required by NEC for the location installed unless more stringent requirements otherwise noted on the Drawings or herein. Provide secondary enclosures where primary enclosures do not conform to NEC requirements.

PART 2 PRODUCTS

2.01 MANUAL MOTOR CONTROLLER, SINGLE PHASE

- A. Acceptable Manufacturer: Square D
- B. General: Manual toggle switch with handle guard and lockoff, thermal overload relay, red pilot indicator light, NEMA 1 surface mounted enclosure. Square D, Class 2510 or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install devices in accordance with manufacturer's recommendations.
- B. In finished areas, mount controllers flush and install suitable cover plates.

SLEEVES, SLEEVE SEALS, AND ESCUTCHEONS FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes sleeves, sleeve seals, escutcheons, and related materials.

1.02 ACTION SUBMITTALS

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

PART 2 PRODUCTS

2.01 SLEEVES

- A. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- B. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

2.02 STACK SLEEVE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Jay R. Smith Mfg. Co.
 - 2. Zurn Industries
- 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.

2.03 SLEEVE SEAL FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. GPT, an EnPro Industries company.
 - 2. Metraflex Company (The).
- 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.

2.04 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Non-shrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.05 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated or 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. Split-Casting Brass Type: With polished, chrome-plated or rough-brass finish and with concealed hinge and setscrew.

2.06 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 EXECUTION

3.01 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 annular clear space between piping and concrete slabs and walls recommended by manufacturer.
 - 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. 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.
 - 2. 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.
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. See Section 22 05 00 – General Plumbing Provisions.

3.02 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.
 - 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. See Section 22 05 00 General Plumbing Provisions.

3.03 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.

3.04 SLEEVE AND SLEEVE SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Concrete Slabs-on-Grade: Sleeve-seal fittings.
 - 2. Concrete Slabs above Grade: Stack-sleeve fittings.
 - 3. Interior Partitions: Galvanized-steel-pipe sleeves.

3.05 ESCUTCHEONS

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 piping and with OD that completely covers opening.
- C. Use one-piece, deep-pattern escutcheons for new piping where fittings would protrude from the wall and be exposed if standard escutcheons were used
- D. Escutcheons for New Piping:
 - 1. Finished Areas: One-piece, cast-brass type with polished, chrome-plated finish.
 - 2. Unfinished Areas: One-piece, cast-brass type, rough brass finish.
- E. Install floor plates for piping penetrations of equipment-room floors.
- F. 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.

METERS AND GAUGES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Thermometers and thermowells.
 - 2. Pressure gauges and gauge attachments.
 - 3. Test plugs.

1.02 ACTION SUBMITTALS

- A. Provide submittals for products listed in the Product Table below in accordance with Section 22 05 00 – General Plumbing Provisions. Submittal requirements indicated by column number designation as follows:
 - 1. Materials List
 - 2. Catalog Data
 - 3. Product Data
 - 4. Performance Data
 - 5. Wiring Diagrams
 - 6. Shop Drawings
 - 7. Installation Instructions
 - 8. Special Requirement listed herein.

PRODUCT TABLE	1	2	3	4	5	6	7	8
Thermometers, Thermowells, and Ac-								
cessories								
Pressure Gauges and Gauge Attach-								
ments								
Test Plugs								

1.03 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gauges to include in operation and maintenance manuals.

PART 2 PRODUCTS

2.01 THERMOMETERS AND THERMOWELLS

- A. Bi-metallic actuated Thermometers
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ashcroft Inc.
 - b. Marsh Bellofram.
 - c. Palmer Wahl Instrumentation Group.
 - d. Trerice, H. O. Co.
 - e. Watts, A Watts Water Technologies Company.
 - f. Weiss Instruments, Inc.
 - 2. Standard: ASME B40.200.
 - 3. Case: Sealed type. Stainless steel with 5-inch nominal diameter.
 - 4. Dial: Non-reflective aluminum with permanently etched scale markings and scales in degrees F.
 - 5. Connector Type(s): Union joint, adjustable angle, rigid back, or rigid bottom selected for ease of reading. Unified-inch screw threads.
 - 6. Connector Size: 1/2 inch, with ASME B1.1 screw threads.
 - 7. Stem: 0.25 or 0.375 inch in diameter; stainless steel.
 - 8. Window: Double strength glass or plastic.
 - 9. Ring: Stainless-steel.

- 10. Element: Bimetal coil.
- 11. Pointer: Dark-colored metal.
- 12. Accuracy: Plus or minus 1 percent of scale range.
- B. Thermowells
 - 1. Standard: ASME B40.200.
 - 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
 - 3. Material for Use with Copper Tubing: CNR or CUNI.
 - 4. Material for Use with Steel Piping: CRES.
 - 5. Type: Stepped shank unless straight or tapered shank is indicated.
 - 6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
 - 7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
 - 8. Bore: Diameter required to match thermometer bulb or stem.
 - 9. Insertion Length: Length required to match thermometer bulb or stem.
 - 10. Lagging Extension: Include on thermowells for insulated piping and tubing.
 - 11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
 - 12. Heat Transfer Medium: Mixture of graphite and glycerin

2.02 PRESSURE GAUGES AND GAUGE ATTACHMENTS

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gauges
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ashcroft Inc.
 - b. Palmer Wahl Instrumentation Group.
 - c. Trerice, H. O. Co.
 - d. Weiss Instruments, Inc.
 - 2. Standard: ASME B40.100.
 - 3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
 - 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 - 5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 - 6. Movement: Mechanical, with link to pressure element and connection to pointer.
 - 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
 - 8. Pointer: Dark-colored metal.
 - 9. Window: Double strength glass or plastic.
 - 10. Ring: Metal, Friction fit.
 - 11. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.
 - 12. Scale: Black printing on white. 270-degree arc, 0 to 60 range, 1 psi increments. 0 to 100 psi range, 1 psi increments, or as required for system pressure encountered. Range selected so that operating pressure approximately half of full range or maximum scale value exceeds maximum pressure, whichever scale range is greater.
- B. Gauge Attachments
 - 1. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and porousmetal-type surge-dampening device. Include extension for use on insulated piping.
 - 2. Valves: Brass ball, with NPS 1/4, ASME B1.20.1 pipe threads.

2.03 TEST PLUGS

- 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. FNW.
 - 2. Pete's Plug.
 - 3. Sisco Manufacturing Company, Inc.
 - 4. Trerice, H. O. Co.
 - 5. Watts; a Watts Water Technologies company.
 - 6. Weiss Instruments, Inc.

- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Lead-free brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- F. Core Inserts: Chlorosulfonated polyethylene synthetic acceptable for air, gas, oil, and water. EPDM self-sealing rubber acceptable for air and water only.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install all equipment in accordance with manufacturer's recommendations.
- B. Thermometers
 - 1. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- C. Thermowells
 - 1. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.
 - 2. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
 - 3. Install thermowells with extension on insulated piping.
 - 4. Fill thermowells with heat-transfer medium.
- D. Pressure Gauges
 - 1. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at the most readable position.
 - 2. Install valve and snubber in piping for each pressure gauge for fluids.
- E. Test Plugs
 - 1. Install test plugs in piping tees.
- F. Install meters and gauges adjacent to machines and equipment to allow service and maintenance of meters, gauges, machines, and equipment.

3.02 THERMOMETER SCALE RANGE SCHEDULE

- A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F.
- B. Scale Range for Domestic Hot-Water Piping: 20 to 240 deg F.

3.03 PRESSURE GAUGE SCALE RANGE SCHEDULE

- A. Scale Range for Water Service Piping: 0 to 100 psi.
- B. Scale Range for Domestic Water Piping: 0 to 100 psi.

3.04 AD USTING

A. Adjust faces of meters and gauges to proper angle for best visibility.

VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes valves for plumbing service.

1.02 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NRS: Non-rising stem.
- D. RS: Rising stem.

1.03 ACTION SUBMITTALS

- A. Provide catalog data for each type of valve.
- B. Provide certification that products comply with NSF 61.

1.04 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.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.1 for flanges on iron valves.
 - 2. ASME B16.5 for flanges on steel valves.
 - 3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 4. ASME B31.9 for building service piping valves.
- C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- E. NSF Compliance: NSF 372 for valve materials for potable-water service.
- F. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures. If valves with specified SWP classes or CWP ratings are unavailable, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- G. Valve Sizes: Same as upstream piping unless otherwise indicated.
- H. Valves in Insulated Piping:
 - 1. Include 2-inch stem extensions.
 - 2. Ball Valves:

a. Extended operating handle of nonthermal-conductive material, and protective sleeves that allow operation of valves without breaking the vapor seals or disturbing insulation.

2.02 BALL VALVES

- A. NPS 3 and Smaller:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves/Conbraco Industries, Inc.
 - b. Hammond Valve.
 - c. Jenkins Valves; Crane Energy Flow Solutions.
 - d. NIBCO INC.
 - e. Stockham; Crane Energy Flow Solutions.
 - 2. Two-Piece Bronze Ball Valves with Full Port and Bronze or Brass Trim:
 - 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.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass or stainless-steel.
 - j. Port: Full.
 - k. Packing: Adjustable.

2.03 CHECK VALVES

- A. Bronze, Swing Check Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves/Conbraco Industries, Inc.
 - b. Crane; Crane Energy Flow Solutions.
 - c. Hammond Valve.
 - d. Jenkins Valves; Crane Energy Flow Solutions.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Stockham; Crane Energy Flow Solutions.
 - 2. Class 125, Bronze Swing Check Valves with Bronze Disc
 - a. Standard: MSS SP-139, Type 3.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 584, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze. Renewable seats and disc.
- B. Bronze, Lift Check Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves/Conbraco Industries, Inc.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. Mueller Steam Specialty.
 - e. NIBCO INC.
 - f. Spence Engineering Company, Inc.

- 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B61 or ASTM B62, bronze.
 - e. Style: Threaded.
 - f. Disc: Bronze.
- C. Bronze Swing Check Valves with Non-Metallic Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves/Conbraco Industries, Inc.
 - b. Crane; Crane Energy Flow Solutions.
 - c. Hammond Valve.
 - d. Jenkins Valves; Crane Energy Flow Solutions.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Stockham; Crane Energy Flow Solutions.
 - Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 584, bronze.
 - e. Ends: Threaded.
 - f. Disc: Rubber or PTFE.

2.04 DRAIN VALVES

2.

2.

- A. NPS 2 and Smaller:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves/Conbraco Industries, Inc.
 - b. Hammond Valve.
 - c. Jenkins Valves; Crane Energy Flow Solutions.
 - d. NIBCO INC.
 - e. Stockham; Crane Energy Flow Solutions.
 - Two-Piece Bronze Ball Valves with Full Port and Bronze or Brass Trim:
 - 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. Inlet: Threaded.
 - g. Outlet: Threaded with 3/4-inch male hose threaded adapter.
 - h. Seats: PTFE.
 - i. Stem: Stainless-steel.
 - j. Ball: Chrome-plated brass or stainless-steel.
 - k. Port: Full.
 - I. Packing: Adjustable.
 - m. Cap: Brass with EPDM gasket and brass chain.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine mating flange faces for damage. 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.
- D. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

- A. Install valves with unions or flanges to isolate 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, with handle swing in direction of flow.
- E. Install check valves a minimum of five pipe diameters away from changes of direction, pumps, or equipment that can generate turbulent flow in piping.

3.03 AD USTING

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

3.04 GENERAL VALVE APPLICATIONS.

- A. Provide valves for isolation of services as shown on Drawings and at the following locations:
 - 1. Where piping enters the building.
 - 2. At branch connections from piping risers at each floor.
 - 3. Major branches and branches to remote equipment or fixtures for all supply and return systems.
 - 4. As required to individually isolate all equipment and maintainable devices including automatic air vents and hydronic control valves.
 - 5. To individually isolate building systems by section.
 - 6. Where piping penetrates mechanical room walls. Locate valve inside mechanical room.
 - 7. Branch connections for utility systems including piping in utility tunnels.
 - 8. Point of entry into individual suites, classroom, or laboratories for all plumbing piping systems.

3.05 PLUMBING VALVE SCHEDULE

- A. Shutoff Service: Two-Piece Bronze Ball Valves with Full Port and Bronze or Brass Trim.
- B. Check Valve General Service: Bronze Swing Check Valves with Bronze Disc.
- C. Check Valve Domestic Water Pump Service:
 1. NPS 2 and Smaller: Bronze Lift Check Valves with Bronze Disc.
- D. Check Valve Sump Pump Service: Bronze Swing Check Valves with Non-Metallic Disc.
- E. Drain, Gauge Stop, Strainer Blowdown: Two-Piece Bronze Drain Valves with Full Port and Bronze or Brass Trim.

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes hangers and supports for plumbing piping and equipment.

1.02 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.03 PERFORMANCE REQUIREMENTS

- A. 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. Supports for multiple pipes, including pipe stands, shall be capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.04 ACTION SUBMITTALS

- A. Provide submittals for products listed in the Product Table below in accordance with Section 22 05 00 – General Plumbing Provisions. Submittal requirements indicated by column number designation as follows:
 - 1. Materials List
 - 2. Catalog Data
 - 3. Detailed Data
 - 4. Performance Data
 - 5. Wiring Diagrams
 - 6. Shop Drawings
 - 7. Installation Instructions
 - 8. Special Requirement listed herein.
 - 9.

PRODUCT TABLE	1	2	3	4	5	6	7	8
Pipe Hangers and Supports								
Thermal Hanger Shield Inserts								

1.05 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

2.01 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: Pre-galvanized 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. 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.

2.02 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.

2.03 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. B-line, an Eaton business.
 - b. Thomas & Betts Corporation; A Member of the ABB Group.
 - c. Unistrut; Part of Atkore International.
 - 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 carbon steel.
 - 7. Metallic Coating: Electroplated zinc or hot-dipped galvanized.

2.04 INSULATION INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. National Pipe Hanger Corporation.
 - 2. Pipe Shields Inc.
 - 3. Insulshield
 - 4. Uni-Grip
- B. General: Insulation insert for use with MSS Type 40 protection saddle.
- C. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.
- 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.

2.05 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened Portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.06 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.

2.07 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbonsteel shapes.

2.08 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, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Non-staining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 EXECUTION

3.01 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.
 - 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- D. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- G. 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.
- H. Install lateral bracing with pipe hangers and supports to prevent swaying.
- I. 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.
- J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. 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.
- L. Insulated Piping:
 - 1. Piping Operating Above Ambient Air Temperature:
 - a. Steel Piping 4-inches and Larger: Provide MSS Type 39 Protective Saddle.
 - b. All Other Piping: Provide Insulation Insert with MSS Type 40 protection shield.
 - 2. Piping Operating Below Ambient Air Temperature:
 - a. Provide Insulation Insert with MSS Type 40 protection shield.
 - 3. 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.
- 4. Insulation Inserts: Same thickness as piping insulation.

3.02 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.

3.03 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.

3.04 AD USTING

- 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.

3.05 PAINTING

- A. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.06 HANGER SPACING

Α.

PLUMBING PIPING SPACING TABLE	Maximum Horizontal Span	Maximum Vertical Spacing				
Carbon Steel and Stainless-Steel						
1-1/4 inch and smaller	7 feet	15				
1-1/2 inch to 2-1/2 inch	10 feet	15				
3 inch and larger	12 feet	15				
Copper Tubing						
³ / ₄ inch and smaller	5 feet	10				
1 inch to 2 inch	7 feet	10				
2-1/2 inch and larger	10 feet	10				
PVC less than 100°F and CPVC less than 130°F						
All Sizes	4 feet	10				
PE						
All sizes	32 inches	10				
Cast Iron						
All sizes	5 feet except where 10 foot lengths are installed.					

3.07 ROD SIZES

A. Select rod diameter to not exceed the maximum safe load listed in Table 2 of MSS SP-58-2009.

3.08 HANGER AND SUPPORT SCHEDULE

- A. Single Pipe, Hung and Uninsulated
 - 1. NPS 1/2 to NPS 3: Adjustable Steel Band Hanger, MSS Type 7.
 - 2. NPS 4 and Larger: Steel Clevis, MSS Type 1.
- B. Single Pipe, Hung and Insulated
 - 1. Operating Temperature Less Than Ambient: Steel Clevis, MSS Type 1
 - 2. Operating Temperature Greater Than Ambient.
 - a. NPS ¹/₂ to NPS2: Steel Clevis, MSS Type 1.
 - b. NPS 3 and Larger: Adjustable Roller Hanger: Type 43.
- C. Multiple Pipe Trapeze or Pipe Rack: Trapeze Hanger, MSS Type 59.
 - 1. Uninsulated Piping: Steel Strap.
 - 2. Insulated Piping: Adjustable Roller, MSS Type 43.
- D. Single Pipe Floor Support: Adjustable Pipe Support Saddle: MSS Type 38.
- E. Vertical Piping: For riser support and restraint see Section 22 05 48 Vibration and Seismic Controls for Plumbing Piping and Equipment.
- F. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- G. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- H. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.
- I. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- J. Use padded hangers for piping that is subject to scratching.
- K. To eliminate the need for seismic restraint, for piping installation where the distance from the top of the pipe to the structure is 12 inches or less for the entire run, select hanger-rod and building attachments to allow pipe movement without stress on hangers and attachments.
- L. Horizontal-Piping Hangers and Supports: 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°F piping installations.
 - 3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 - 4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450°F piping installations.
- M. 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.
- N. 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°F piping installations.
 - 3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 - 4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450°F piping installations.
- O. 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 Ibeams for heavy loads.
- 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel Ibeams 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.
- P. 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.
- Q. 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.
- R. Vertical-Piping Supports: Unless otherwise required, 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.
 - 3. For additional riser support requirements, refer to Section 22 05 48 Vibration and Seismic Controls for Plumbing Piping and Equipment.
- S. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications.
- T. Comply with MFMA-103 for metal framing system selections and applications.
- U. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- V. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Design and installation of vibration isolation systems, piping riser support, and seismic restraint components listed for new plumbing equipment and piping provided in Division 22 as scheduled or described herein.

1.02 DEFINITIONS

A. OSHPD: Office of Statewide Health Planning & Development (for the State of California).

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
 - 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Shop Drawings:
 - 1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.
 - 1. Provide a delegated submittal package comprised of drawings, details, and calculations signed and sealed by an engineer specializing in the associated work and registered in Oregon. Submittals shall indicate full compliance with the device specification in Part 2. Any deviation shall be specifically noted and subject to engineer approval. Submittals shall include device dimensions, placement, and attachment and anchorage requirements.
 - 2. All restraining devices shall have a pre-approval number from California OSHPD or some other organization acceptable to the Authority Having Jurisdiction. Where pre-approved devices are not available, provide submittals based on independent testing or calculations stamped by a registered professional engineer with at least five years of seismic design experience and licensed in the state of Oregon.
 - 3. Piping Restraint:
 - a. Provide full or half size copies of piping plans from the Contract Documents or coordination drawings, showing location and type of each vibration isolation component and seismic restraint to be installed. Drawings shall consist of mechanically reproduced copies of the Contract Documents, or new drawings custom drafted specifically for the Work of this Project. Each drawing shall be printed on a single sheet.
 - b. Provide spring hangers or spring floor supports for the first three supports from any equipment that produces vibration. The spring deflection shall match the equipment isolation deflection.
 - c. Provide spring hangers or spring floor supports for the first three supports from any vertical piping riser greater than 20 feet in elevation.
 - d. Provide piping restraint assembly construction and installation details. Assemblies may be pre-engineered or custom designed for the application.

- e. Where walls, floors, slabs or supplementary steel work are used for seismic restraint locations, details of acceptable attachment methods for pipe must be included and approved before the condition is accepted for installation. Restraint manufacturers' submittals must include spacing, static loads and seismic loads at all attachment and support points.
- 4. Equipment Restraint
 - a. Select vibration isolators and accessories as scheduled and as required to meet seismic restraint requirements.
 - b. Provide equipment seismic restraint assembly construction and installation details. Assemblies may be pre-engineered or custom designed for the application. Include method of attachment to supporting structure.
 - c. Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.
- 5. Calculations: Provide design calculations to verify that seismic restraint will comply with the current Oregon Structural Specialty Code for the site and the building type listed.
- 6. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Provide seismic design in accordance with current Oregon State Structural Specialty Code and ASCE/SEI 7.
- B. Refer to structural notes for project specific seismic requirements.
- C. Risk Category: IV
- D. Component Importance Factor (Ip)
 - 1. All components Ip 1.0.

2.02 FREE STANDING SPRING MOUNTS

- A. Freestanding, Seismically Restrained, Open-Spring Isolators (SM-1)
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibro-Acoustics
 - 2. Basis of Design: Mason Industries Type SSLFH
 - 3. Free standing laterally supported with neoprene cup or ¼ inch neoprene acoustical friction pads between spring and support. Leveling bolts.
 - 4. Spring diameter no less than 80 percent of the compressed height of the spring at rated load.
 - 5. Spring to have an additional minimum travel to solid equal to 50 percent of the rated deflection.
 - 6. Ductile iron or steel housing to resist motion due to earthquake loads in all directions. Minimum 0.5 G rating.
 - 7. Minimum clearance of ¼-inch to be maintained between the restraining bolts and a molded neoprene bushing so as not to interfere with spring action
 - 8. The housing shall be out of contact during normal operating.
 - 9. Deflection as scheduled.

2.03 PIPE RISER RESILIENT SUPPORT

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Kinetics Noise Control, Inc.
 - 2. Mason Industries, Inc.

- B. Basis of Design: Mason Industries Type ADA.
- C. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch-thick neoprene.
 - 1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
 - 2. Maximum Load Per Support: 500 psig in isolation material providing equal isolation in all directions.

2.04 SPRING HANGERS

- A. Spring and Neoprene Hanger with Vertical Restraint: (SH-1)
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibro-Acoustics
 - 2. Basis of Design: Mason Industries Type RW30N
 - 3. 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.
 - 4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 8. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 - 9. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 - 10. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support.

2.05 SNUBBERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Kinetics Noise Control, Inc.
 - 2. Mason Industries, Inc.
- B. Basis of Design: Mason Industries Type Z-1225 or Series Z-1011
- C. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
 - 1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 - 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 - 3. Maximum 1/4-inch air gap, and minimum 1/4-inch-thick resilient cushion.

2.06 RESTRAINT CHANNEL BRACINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. B-line, an Eaton business.
 - 2. Hilti, Inc.
 - 3. Mason Industries, Inc.
- B. Basis of Design: Mason Industries SSBS/SHB
- C. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end. Provide other matching components. Corrosion-resistant coating; rated in tension, compression, and torsion forces.

- D. Accessories:
 - 1. Neoprene clamp cushion. Similar to Unistrut, Cush-A-Clamp

2.07 MECHANICAL ANCHOR BOLTS

- 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. B-line, an Eaton business.
 - 2. Hilti, Inc.
 - 3. Kinetics Noise Control, Inc.
 - 4. Mason Industries
 - 5. Vibro-Acoustics
- B. Basis of Design: Mason Industries SASE, SAST
- C. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.08 ADHESIVE ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hilti, Inc.
 - 2. Kinetics Noise Control, Inc.
- B. Basis of Design: Mason Industries SRA
- C. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.09 SEISMIC RESTRAINT ACCESSORIES

- A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.
- B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.
- D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.
- E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face

PART 3 EXECUTION

3.01 GENERAL

- A. Coordinate locations and sizes of structural supports with locations of vibration isolators and seismic restraints.
- B. Block and shim all bases level so that all piping and electrical connections can be made to a rigid system at the proper operating level, before isolators are adjusted. Ensure that there are no rigid connections or incidental physical contacts between isolated equipment and the building structure or nearby systems.
- C. Ensure housekeeping pads have adequate space to mount equipment and isolator housings and shall also be large enough to ensure adequate edge distance for isolator anchors to prevent breakout.

D. Select and locate vibration isolation equipment to give uniform loading and deflection, according to weight distribution of equipment.

3.02 EXAMINATION

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

3.03 APPLICATIONS

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

3.04 VIBRATION CONTROL AND SEISMIC RESTRAINT DEVICE INSTALLATION

- A. Install all equipment in accordance with manufacturer's recommendations and as shown on seismic design documents.
- B. Installation of vibration isolators must not cause any change of position of equipment or piping resulting in stresses or misalignment.
- C. Elastomeric Isolation Pads: Provide for entire weight bearing surface of equipment base, or as recommended by equipment manufacturer.
- D. Equipment Restraints:
 - 1. Install seismic snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- E. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 3. Brace a change of direction longer than 12 feet.
 - 4. Provide spring hangers or spring floor supports for the first three supports for piping from any equipment that produces vibration and has a motor greater than 1/4 hp.
 - 5. Provide spring hangers or spring floor supports for the first three supports from any vertical riser 1-1/2 inch and larger and greater than 20 feet in elevation.
- F. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- G. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- H. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- I. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- J. Drilled-in Anchors:

- Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.
- 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
- 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
- 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
- 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
- 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.05 AD USTING

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

3.06 VIBRATION CONTROL AND SEISMIC RESTRAINT DEVICE SCHEDULE

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А.	

VIBRATION ISOLATION AN	D SEISMIC RESTRAINT SCHED	JLE		
EQUIPMENT		SLAB ON GRADE	ABOVE GRADE	
	SPECIFICATION	STATIC DEFLECTION	STATIC DEFLECTION	
Booster Pumps	Spring Isolators Snubbers	0.75"	2.5"	
Pump, in-line suspended, less than ¼ hp	mp, in-line suspended, s than ¼ hp Sthan ½ hp Sthan ½ hp Sthan ½ hp Sthan ½ hp Sthan ½ hp Spring hanger SH-1 or Restraint channel w/ cushion Spring hanger SH-1 or Clamp. Flexible connectors		0.5	

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Pipe labels.
 - 3. Valve tags.
 - 4. Ceiling labels.

1.02 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.

1.03 COORDINATION

A. Coordinate with Divisions 21 and 23. Match manufacturer, type, and style of identification used.

PART 2 PRODUCTS

2.01 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Marking Services, Inc.
 - c. Seton Identification Products
 - 2. Material and Thickness: Aluminum, 0.032-inch minimum thickness and having predrilled or stamped holes for attachment hardware.
 - 3. Letter Color: Black.
 - 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 5. 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-quarters the size of principal lettering.
 - 6. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 7. 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. Engraved to show white lettering on black background except for labels attached to ceiling grid or located within finished spaces shall have black lettering on white background.
 - 3. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 - 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 5. Minimum Letter Size: 1/2-inch height.
 - 6. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- C. Label Content: Include equipment's Drawing designation or unique equipment number,
- D. Equipment Label Schedule: For each item of equipment to be labeled, prepare an equipment label schedule 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) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.02 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pre-tensioned Pipe Labels: Pre-coiled, semi-rigid 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; also include 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: Size letters according to ASME A13.1 for piping.
- E. Union Labels:
 - 1. Lettering and Background Colors: White background, red lettering.
 - 2. Lettering Size: 1/2 inch minimum height.
 - 3. Label Content: Labels for unions and di-electric unions to read "UNION".

2.03 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, 0.025-inch minimum thickness and having predrilled or stamped holes for attachment hardware.
 - 2. Minimum Tag Size: 1-1/2 inches, round.
 - 3. Fasteners: Brass wire-link 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.

2.04 CEILING LABELS

- A. Self-Adhesive Ceiling Labels: Printed clear plastic with contact-type, permanent-adhesive backing.
 - 1. Minimum Letter Size: 1/2-inch minimum height.
 - 2. Letter Color: Black.
 - 3. Label Content: Equipment identification label and number.

PART 3 EXECUTION

3.01 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.

3.02 GENERAL INSTALLATION REQUIREMENTS

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. Label inside of access doors with equipment name or general purpose of equipment behind access door with stenciled sign or markers.
- C. Install identifying devices before installing acoustical ceilings and similar concealment. Provide ceiling labels on ceilings or ceiling grid (not the tile) to indicate key access points for equipment, valves, and other components requiring quick access or routine maintenance that will be concealed above ceilings.

3.03 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of plumbing equipment. Labels are required for plumbing equipment scheduled on drawings, and for the following:
 - 1. Reduced-pressure-principle backflow preventers.
 - 2. Double-check, backflow-prevention assemblies.
 - 3. Reduced-pressure-detector, fire-protection, backflow-preventer assemblies.
 - 4. Double-check, detector-assembly backflow preventers.
 - 5. Primary, thermostatic, water mixing valves.
 - 6. Manifold, thermostatic, water mixing-valve assemblies.
 - 7. Trap-seal primer systems.
- B. Locate equipment labels where accessible and visible.

3.04 PIPE LABEL INSTALLATION

- A. Pipe Label Locations: 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 flange.
 - 3. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 4. Within 3 feet of penetrations through walls, floors, ceilings, inaccessible enclosures, valves, equipment connections, and branch connections.
 - 5. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 6. Near major equipment items and other points of origination and termination.
 - 7. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
- B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- C. Pipe Label Color Schedule: Letter and background color in accordance with ANSI A13.1.

3.05 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 Information. Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch valve tag numbers.

TESTING, AD USTING, AND BALANCING FOR PLUMBING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Balancing domestic water systems and equipment.

1.02 DEFINITIONS

- A. AABC: Associated Air Balance Council
- B. ASHRAE: American Society of Heating, Refrigerating, and Air Conditioning Engineers
- C. ASPE: American Society of Plumbing Engineers
- D. BAS: Building automation systems
- E. NEBB: National Environmental Balancing Bureau
- F. TAB: Testing, adjusting, and balancing
- G. TAB Specialist: An independent entity meeting qualification to perform TAB work
- H. TAB Project Supervisor: Certified individual employed by balancing contractor having administrative and technical responsibility for work performed under this Section

1.03 ACTION SUBMITTALS

A. TAB Report: Documentation indicating that Work complies with ASHRAE/IES 90.1, Section 6.7.2.3 – "System Balancing"

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 15 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in Part 1 "Quality Assurance" and Part 3 "TAB Specialist."
- B. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- C. System Readiness Checklists: Within 60 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.
- D. Instrument Calibration Report: Within 60 days of Contractor's Notice to Proceed, Engineer reserves the right to request recalibration of any measuring instrument which has not been recalibrated within the past year. Report to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.
 - 5. Dates of calibration.
- E. TAB reports.
 - 1. Required Submittals:
 - a. Draft TAB Report: Submit prior to substantial completion to indicate to Architect, Engineer, and Contractor incomplete work or issues to be resolved before final balancing is completed.
 - b. Certified Final TAB Report: Submit within 30 days of fieldwork completion.
 - 2. Report Format: Electronic file in PDF format, bookmarked by systems balanced, assembled in order as follows:
 - a. Transmittal letter
 - b. Cover sheets with project title, project location, submittal date, names and addresses of Owner, Contractor, TAB subcontractor, Architect, and Engineer
 - c. Index
 - d. Data organized by system in order:
- 1) Equipment data and measurement summary
- 2) Equipment measurement data
- 3) Branch main measurement data
- 4) Terminal device measurement data

1.05 QUALITY ASSURANCE

- A. All work under this Section shall be performed under the direction of the Certified TAB Supervisor.
- B. TAB Specialists Qualifications: Certified by AABC or NEBB
 - 1. TAB Supervisor: Employee of the TAB specialist and certified by AABC or NEBB
 - 2. TAB Technician: Employee of the TAB specialist working under the supervision of the TAB Supervisor
- C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

1.06 FIELD 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.
- PART 2 PRODUCTS Not Applicable

PART 3 EXECUTION

3.01 TAB SPECIALISTS

- A. Subject to compliance with requirements, engage one of the following:
 - 1. Air Balancing Specialties.
 - 2. Air Introduction and Regulation, Inc.
 - 3. Neudorfer Engineering, Inc.

3.02 EXAMINATION

- A. Contract Document Examination:
 - 1. 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.
 - 2. Confirm that balancing devices and provisions are included to facilitate TAB work. Provide listing of any devices and provisions required that are not included in the Contact Documents.
 - 3. Contract Documents Examination Report: Based on examination of the Contract Documents, 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 plumbing systems and general construction to allow access for performance measuring and balancing devices.
- B. Construction Examination:
 - 1. Examine the approved submittals for plumbing systems and equipment.
 - 2. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, and balancing valves and fittings. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
 - 3. Examine design data including plumbing system descriptions, statements of design assumptions for flow rates and systems output, and statements of philosophies and assumptions about plumbing system and equipment controls.
 - 4. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
 - 5. Examine test reports specified in individual system and equipment Sections.

- 6. Examine plumbing equipment and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- 7. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.
- 8. Examine control valves for proper installation and orientation for their intended function of throttling, diverting, or mixing fluid flows. Verify the pipe connections are in accordance with manufacturers recommendations.
- 9. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- 10. Examine system pumps to ensure absence of entrained air in the suction piping.
- 11. 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.

3.03 PREPARATION

- A. Strategies and Procedures Plan: Prepare a TAB plan that includes the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.
 - 5. For non-standard water systems, include procedures for adjusting measurements for different viscosities.
 - 6. Sample forms with specific identification for all equipment.
 - 7. References to published standards of NEBB or AABC.
- B. Prepare system-readiness checks of plumbing systems and equipment to be executed by the Plumbing Contractor to verify system readiness for TAB work. Include, at a minimum, the following:
 - 1. Domestic Water:
 - a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
 - b. Piping is complete with fixture and equipment connections made.
 - c. Water sanitization is complete.
 - d. Strainers are pulled and cleaned.
 - e. Control valves are functioning per the sequence of operation.
 - f. Shutoff and balance valves have been verified to be 100 percent open.
 - g. Pumps are started and proper rotation is verified.
 - h. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
 - i. Variable-frequency and electronically commutated motor controllers' startup is complete, and safeties are verified.
 - j. Suitable access to balancing devices and equipment is provided.

3.04 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
- B. Cut insulation, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 22 07 19 Plumbing Piping Insulation.
- C. Mark equipment and balancing devices, including valve position indicators 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.

3.05 GENERAL PROCEDURES FOR DOMESTIC WATER SYSTEMS

- A. Prepare test reports for pumps, water heaters, heat exchangers, thermostatic mixing valves, and balancing valves. Obtain approved submittals and manufacturer-recommended testing procedures.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare domestic water systems for testing and balancing as follows:
 - 1. Check air charge in expansion tank.
 - 2. Check valves for proper position.
 - 3. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
 - 4. Verify that motor starters are equipped with properly sized thermal protection.
 - 5. Check that air has been purged from the system.
- D. Flow Adjustments:
 - 1. Perform temperature tests after flows have been balanced.
 - 2. Adjust memory stops on balancing devices.
- E. Pump Pressure Measurements:
 - 1. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
 - 2. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
 - 3. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

3.06 PROCEDURES FOR MOTORS

- A. Motor Measurement and Verification:
 - 1. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - a. Manufacturer's name, model number, and serial number.
 - b. Motor horsepower rating.
 - c. Motor rpm.
 - d. Phase and hertz.
 - e. Nameplate and measured voltage, each phase.
 - f. Nameplate and measured amperage, each phase.
 - g. Starter size and thermal-protection-element rating.
 - h. Service factor and frame size.
 - 2. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.
- B. Motor Speed Adjustments:
 - 1. Obtain approval from Engineer for adjustment of pump motor speeds higher than the motor synchronous speed indicated for induction motors.
 - 2. Obtain approval from Engineer prior to making pump-speed adjustments that result in motor operation above the motor RLA. Measure amperage in all operating modes to determine the maximum required motor amperage.

3.07 TOLERANCES

- A. Set plumbing system's flow rates within the following tolerances:
 - 1. Domestic Hot Water Flow Rate: Plus or minus 10 percent.

3.08 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
 - 3. Certify validity and accuracy of field data.

- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Pump curves.
 - 2. Manufacturers' test data.
 - 3. Field test reports prepared by system and equipment installers. Test reports shall be fully executed reports forms confirming to standard NEBB or AABC documentation standards.
 - 4. 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 specialist.
 - 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 plumbing equipment, 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.
- D. System Diagrams: Include schematic layouts of domestic hot water distribution system. Present each system with single-line diagram and include the following:
 - 1. Water flow rates, as applicable.
 - 2. Air flow rates, as applicable.
 - 3. Pipe and valve sizes and locations.
 - 4. Pipe and valves sizes and locations.
 - 5. Balancing stations.
 - 6. Thermostatic mixing valves.
 - 7. Pressure regulating devices.
 - 8. Position of balancing devices.
- E. Instrument Calibration Reports:
 - 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

END OF SECTION

SECTION 22 0719

PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes insulating plumbing piping services:

1.02 ACTION SUBMITTALS

- A. Provide submittals for products listed in the Product Table below in accordance with Section 22 05 00 – General Plumbing Provisions. Submittal requirements indicated by column number designation as follows:
 - 1. Materials List
 - 2. Catalog Data
 - 3. Product Data
 - 4. Performance Data
 - 5. Wiring Diagrams
 - 6. Shop Drawings
 - 7. Installation Instructions
 - 8. Special Requirement listed herein.

PRODUCT TABLE	1	2	3	4	5	6	7	8
Insulation Materials								
Field Applied Jackets								

- B. Special Requirements
 - 1. Product Data: For each type of insulation product listed, provide thermal conductivity and water-vapor permeance.

1.03 QUALITY ASSURANCE

- A. Insulation materials and accessories shall be installed in a professional manner by skilled and experienced workers who specialize in commercial insulation work.
- 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.

1.04 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 22 05 29 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.

1.05 SCHEDULING

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

PART 2 PRODUCTS

2.01 INSULATION MATERIALS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. 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.
- C. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. Knauf Insulation.
 - c. Manson Insulation Inc.
 - d. Owens-Corning.
 - 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-SSL. Factoryapplied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.02 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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
- D. PVC Jacket Adhesive: Compatible with PVC jacket.

2.03 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
 - 1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 2. Service Temperature Range: Minus 20 to plus 180°F.
 - 3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 - 4. Color: White.

2.04 FACTORY APPLIED ACKETS

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

2.05 FIELD APPLIED ACKETS

- 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. P.I.C. Plastics, Inc.
 - c. Proto Corporation.
 - 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.

2.06 **TAPES**

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Width: 3 inches.
 - 2. Thickness: 11.5 mils.
 - 3. Adhesion: 90 ounces force/inch in width.
 - 4. Elongation: 2 percent.
 - 5. Tensile Strength: 40 lbf/inch in width.
 - 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
 - 1. Width: 2 inches.
 - 2. Thickness: 6 mils.
 - 3. Adhesion: 64 ounces force/inch in width.
 - 4. Elongation: 500 percent.
 - 5. Tensile Strength: 18 lbf/inch in width.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 - 1. Width: 2 inches.
 - 2. Thickness: 3.7 mils.
 - 3. Adhesion: 100 ounces force/inch in width.
 - 4. Elongation: 5 percent.
 - 5. Tensile Strength: 34 lbf/inch in width.

2.07 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Insul-Tect Products Co.
 - b. McGuire Manufacturing.
 - c. Truebro.
 - 2. Description: Manufactured plastic wraps for covering plumbing fixture trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install 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.
- C. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- D. Install multiple layers of insulation with longitudinal and end seams staggered.
- E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. 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.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. 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 4 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.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. 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.
- O. 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.

3.04 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations: Install insulation continuously through walls and partitions.
- B. Insulation Installation at Floor Penetrations: Install piping insulation continuously through floor penetrations.

3.05 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 - 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 - 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 - 8. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 - 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at the following:
 - 1. Flanges and unions requiring access to allow equipment service.
 - 2. Mechanical couplings requiring access to allow equipment service.

3.06 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.

3.07 FIELD APPLIED ACKET INSTALLATION

- A. 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.

3.08 PIPING INSULATION THICKNESS

- A. General
 - 1. For piping smaller than 1-1/2 inches and located in partitions within conditioned spaces, reduction of thickness by 1-inch permitted to a thickness not less than 1-inch.

B. Mineral Fiber Insulation

FIBERGLASS							
FLUID NORMAL OPERATING TEMPERATURE (°F)	NOMINAL PIPE OR TUBE SIZE (inches)						
		1 to	1.5 to	4 to			
	1	1.5	4	8	8		
350	5	5	5	5	5		
251-350	3.5	4.5	4.5	4.5	4.5		
201-250	2.5	2.5	2.5	3	3		
141-200	1.5	1.5	2	2	2		
105-140	1	1	1.5	1.5	1.5		
40-60	0.5	0.5	1	1	1		
40	0.5	1	1	1	1.5		

3.09 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. For all systems with an operating temperature that may be below ambient conditions, a vapor barrier must be maintained.
- C. 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.

3.10 INDOOR PIPING INSULATION SCHEDULE

- A. Base insulating thickness on operating temperature unless thickness is specifically listed in section below.
- B. Potable Cold Water Piping: Normal operating temperature 50°F.
 - 1. Mineral-Fiber, Preformed Pipe Insulation, Type I.
- C. Potable Hot Water and Hot Water Recirculation Piping: Normal operating temperature range 120°F to 140°F.

1. Mineral-Fiber, Preformed Pipe Insulation, Type I.

- D. Stormwater and Overflow:
 - 1. Mineral Fiber, 1-inch
- E. Roof Drain and Overflow Drain Bodies:
 - 1. Mineral Fiber, 1-inch
- F. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
 - 1. Protective Shielding Guard.
- G. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60°F:
 - 1. Mineral Fiber: 1-inch
- H. Hot Service Drains:
 - 1. Mineral Fiber: 1-inch
- I. Hot Service Vents:
 - 1. Mineral Fiber: 1-inch

3.11 INDOOR, FIELD APPLIED ACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the fieldapplied 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. None.
 - 2. PVC: 30 mils thick.

END OF SECTION

SECTION 22 0800

COMMISSIONING OF PLUMBING

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes Commissioning activities required for work of Division 22 Sections including but not limited to construction checks, equipment start-up, functional testing, and operator training.
 - 1. Comply with Section 01 91 13 General Commissioning Requirements for Commissioning activities for Division 22 work.

1.02 SEQUENCING

- A. Provide written notification to Commissioning Provider (CxP) in advance of significant project dates as directed and as listed below.
 - 1. Two weeks prior to start-up of hot water heaters
 - 2. Four weeks prior to installation of lay-in ceiling tiles or other partial concealment of equipment to be commissioned
 - 3. Four weeks prior to any system being ready for balancing

1.03 SUBMITTALS

- A. Provide submittals of systems being commissioned to Owner's Authorized Representative as required by Section 01 91 13.
- B. Contractor to provide electronic copies of work products and other items as specified to support development of commissioning documentation. Refer to Section 01 91 13 for specific submittal requirements.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 FUNCTIONAL TESTING

- A. Contractor shall assist CxP with functional testing as required by Section 01 91 13. Functional Test Plans for each system being commissioned will be prepared by CxP during construction, and will generally include a rigorous verification of instrument calibration, equipment performance, package equipment control system operations, automatic control sequence of operations, fire and life safety sequences, and operator interface functions. CxP will supervise and document functional testing. Contractor shall provide qualified technicians to assist CxP during on-site testing and perform the following functions.
 - 1. Operate equipment and systems as necessary to conduct testing.
 - 2. Manipulate control parameters to simulate test conditions as detailed in Functional Test Plans.
 - 3. Provide proprietary hardware and software as needed to interface with manufacturers packaged control systems.
- B. Labor required for retesting due to failure of equipment, or systems not performing in accordance with Contract Documents shall be provided at no additional cost to Owner.

3.02 SCHEDULE OF SYSTEM BEING COMMISSIONED

- A. Commission systems and equipment listed below including associated equipment, piping, and control systems.
- B. Plumbing Systems:
 - 1. Domestic water heaters
 - 2. Plumbing pumps

END OF SECTION

SECTION 22 1116

DOMESTIC WATER PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes pipe, fittings, and joining methods for potable water piping.

1.02 PERFORMANCE REQUIREMENTS

A. All potable water plumbing piping, equipment, fittings, and accessories shall be capable of withstanding a maximum pressure of 125 psi and a maximum temperature of 140°F. Exceptions would include specific items of equipment where a lower operating pressure is specified.

1.03 ACTION SUBMITTALS

- A. Provide materials list for pipe and fittings.
- B. Provide catalog data for dielectric fittings.

1.04 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

PART 2 PRODUCTS

2.01 PIPING MATERIALS

- A. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G. Plastic piping components shall be marked with "NSF-pw."
- B. Comply with NSF Standard 372 for low lead.

2.02 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.

2.03 STAINLESS STEEL PIPING

- A. Potable-water piping and components shall comply with NSF 61 Annex G.
- B. Stainless-Steel Pipe: ASTM A 312/A 312M, Schedule 10 and Schedule 40.
- C. Stainless-Steel Pipe Fittings: ASTM A 815/A 815M.

2.04 PEX TUBE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Uponor.
 - 2. Viega LLC.
 - 3. Watts Radiant; a Watts Water Technologies company.
- B. Tube Material: PE plastic according to ASTM F 876 and ASTM F 877.
- C. Fittings: ASTM F 1960, cold expansion fittings and reinforcing rings.

2.05 PIPING OINING 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 A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for generalduty brazing unless otherwise indicated.

2.06 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, provide products by one of the following:
 - a. Watts; a Watts Water Technologies company.
 - b. Wilkins.
 - 2. Standard: ASSE 1079.
 - 3. Pressure Rating: 125 psig minimum at 180°F.
 - 4. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Watts; a Watts Water Technologies company.
 - b. Wilkins.
 - 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, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - 2. Non-conducting 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.

PART 3 EXECUTION

3.01 EARTHWORK

A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31.

3.02 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Install piping as indicated unless deviations to layout are approved by Engineer.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance.

- D. Install shutoff valve immediately upstream of each dielectric fitting.
- E. Install water-pressure-reducing valves downstream from building shutoff valves where required to maintain a maximum building service pressure of 80 psi.
- F. Install domestic water piping level and plumb.
- G. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- H. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- J. Install piping to permit valve servicing.
- K. 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.
- L. Install piping free of sags and bends.
- M. Install fittings for changes in direction and branch connections.
- N. Install PE tubing with loop at each change of direction of more than 90 degrees.
- O. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

3.03 OINT 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. 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.

3.04 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
- D. Dielectric Fittings for NPS (DN 125) 6and Larger: Use dielectric flange kits.

3.05 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger, support products, and installation in Section 22 05 29 Hangers and Supports for Plumbing Piping and Equipment.
- B. Support vertical piping and tubing at base and at each floor.

3.06 CONNECTIONS

- A. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- B. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- C. Connect domestic water piping to water-service piping with shutoff valve.
- D. Connect to equipment with pipe sizes indicated but not smaller than the size of the equipment connection. Use flanges instead of unions on equipment NPS 2-1/2 inch and larger

3.07 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. Arrange for inspection in accordance with authority having jurisdiction.
 - c. 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. Prepare test and inspection reports.

3.08 AD USTING

- 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.

3.09 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.

3.10 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. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.
- D. Aboveground domestic water piping, NPS 2-1/2 and larger, shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed joints.
 - 2. Stainless-steel, ASTM A 312/A 312M, Schedule 10 or Schedule 40 piping with stainlesssteel pipe fittings.
- E. Non-potable water trap primer piping 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. PE tube with PE fittings, ASTM F 1960, cold expansion fittings and reinforcing rings or manufacturer's fittings.
- F. Domestic water and building service piping buried underslab or within 5 feet of the building line: NPS 3 and smaller:
 - 1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.

END OF SECTION

SECTION 22 1119

DOMESTIC WATER PIPING SPECIALTIES

PART 1 GENERAL

1.01 ACTION SUBMITTALS

- A. Provide submittals for products listed in the Product Table below in accordance with Section 22 05 00 – General Plumbing Provisions. Submittal requirements indicated by column number designation as follows:
 - 1. Materials List
 - 2. Catalog Data
 - 3. Product Data
 - 4. Performance Data
 - 5. Wiring Diagrams
 - 6. Shop Drawings
 - 7. Installation Instructions
 - 8. Special Requirement listed herein.

PRODUCT TABLE	1	2	3	4	5	6	7	8
All Items this Section								

1.02 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.03 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 Annex G.

2.02 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.03 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers (RPBP-1):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. FEBCO.
 - c. Watts; a Watts Water Technologies company.
 - d. Zurn Industries, LLC.
 - 2. Basis of Design: Febco LF860, 3/4 NPT.
 - 3. Standard: ASSE 1013.
 - 4. Description: Two independent spring-loaded check valves with differential pressure relief valve located between check valves. Pressure relief to open to maintain pressure between check valve, with a minimum of 2 psi less than inlet pressure.
 - 5. Operation: Continuous-pressure applications. All parts accessible for testing and service without removing from line.
 - 6. Capacity: 10 gpm flow at 11 psi pressure drop.
 - 7. Body:
 - a. NPS 2 and smaller: Bronze body, elastomer seat disc.
 - b. NPS 2-1/2 and larger: Bronze, cast iron with interior lining that complies with AWWA C550 or that is FDA approved, steel with interior lining that complies with AWWA C550 or that is FDA approved, or stainless steel. Elastomer seat disc.

- 8. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
- 9. Configuration: Horizontal, straight-through flow or as shown on drawings.
- 10. Accessories:
 - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection. Cast iron or bronze funnel designed to mount directly to backflow preventer assembly and provide code-approved air gap.

2.04 BALANCING VALVES

- A. Calibrated Balancing Valves Globe Type:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Caleffi
 - c. Jomar Valve
 - d. Nexus
 - e. TACO Comfort Solutions, Inc.
 - f. Tunstall Corporation/Macon Controls
 - g. Watts; a Watts Water Technologies company.
 - 2. Description: Globe configuration for flow measurement, flow balancing, and positive shutoff.
 - 3. Type: -pattern globe valve with two readout ports and memory-setting indicator.
 - 4. Body: Brass or bronze.
 - 5. Inlet and Outlet Connections: Threaded.
 - 6. Hand Wheel: Vernier valve position scale with hidden memory stops.
 - 7. Size: Same as connected piping, but not larger than NPS 2.

2.05 TEMPERATURE ACTUATED, WATER MIXING VALVES

- A. Primary, Thermostatic, Water Mixing Valves Mechanical Spaces (MMV-1):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company.
 - b. Lawler Manufacturing Company, Inc.
 - c. Leonard Valve Company.
 - d. Powers.
 - e. Symmons Industries, Inc.
 - f. Zurn Industries, LLC.
 - 2. Standard: ASSE 1017.
 - 3. Pressure Rating: 125 psig minimum unless otherwise indicated.
 - 4. Type: Exposed-mounted, thermostatically controlled, water mixing valve.
 - 5. Material: Bronze body with corrosion-resistant interior components.
 - 6. Connections: Threaded union inlets and outlet.
 - 7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 - 8. Valve Finish: Rough bronze.
 - 9. Piping Finish: Copper.
- B. Individual-Fixture, Water Tempering Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company.
 - b. Apollo Valves; Conbraco Industries, Inc.
 - c. Lawler Manufacturing Company, Inc.
 - d. Leonard Valve Company.
 - e. Powers.

- f. Watts; a Watts Water Technologies company.
- g. Zurn Industries, LLC.
- 2. Standard: ASSE 1070, thermostatically controlled, water tempering valve.
- 3. Pressure Rating: 125 psig minimum unless otherwise indicated.
- 4. Body: Bronze body with corrosion-resistant interior components.
- 5. Temperature Control: Adjustable.
- 6. Inlets and Outlet: Threaded.
- 7. Finish: Rough or chrome-plated bronze.
- 8. Tempered-Water Setting: 110°F.

2.06 STRAINERS FOR DOMESTIC WATER PIPING

- A. -Pattern Strainers:
 - 1. Pressure Rating: 125 psig minimum unless otherwise indicated.
 - 2. Body:

6.

- a. NPS 2 and smaller: Bronze
- b. NPS 2-1/2 and larger: Cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated.
- 3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
- 4. Screen: Stainless steel or brass with round perforations or as indicated.
- 5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 20 mesh wire screen or 0.020-inch perforations.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.037 inch.
 - Drain: Pipe plug with PTFE gasket.

2.07 STEEL, PRECHARGED, POTABLE WATER EXPANSION TANKS

- A. Steel, Precharged, Diaphragm, Expansion Tanks (DET-1):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Bell & Gossett.
 - c. TACO Comfort Solutions, Inc.
 - d. Watts Water Technologies.
 - e. Wessels Company.
 - 2. Description: Steel, vertical, pressured-rated tank with cylindrical sidewalls and with aircharging valve and air precharge.
 - 3. Operation: Factory-installed, butyl-rubber diaphragm.
 - 4. Tank Interior Finish: Materials and thicknesses complying with NSF 61 Annex G barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
 - a. Lining Material: Polypropylene.
- B. Steel, Precharged, Bladder, Expansion Tanks (HPT-1):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Watts Water Technologies.
 - c. Bell & Gossett.
 - d. TACO Comfort Solutions, Inc.
 - e. Wessels Company.
 - 2. Description: Steel, vertical, pressured-rated tank with cylindrical sidewalls and with aircharging valve and air precharge.
 - 3. Operation: Factory-installed, butyl-rubber bladder.
 - 4. Construction: ASME code, steel, constructed with nontoxic welded joints, for 125-psig working pressure.
 - 5. Tappings: Factory-fabricated stainless steel, welded to tank before testing and labeling.
 - a. NPS 2 and Smaller: ASME B1.20.1, with female thread.
 - b. NPS 2-1/2 and Larger: ASME B16.5, flanged.

- 6. Vertical Tank Supports: Factory-fabricated steel legs or steel skirt, welded to tank before testing and labeling.
- 7. Exterior Coating: Manufacturer's standard enamel paint or primer paint.

2.08 OUTLET BOXES

- A. Icemaker Outlet Boxes (IMB-1):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Guy Gray Manufacturing Co., Inc.
 - b. IPS Corporation.
 - c. LSP Products Group, Inc.
 - d. Oatey.
 - 2. Mounting: Recessed.
 - 3. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.
 - 4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
 - 5. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.09 HOSE BIBBS

- A. Hose Bibbs (HB-1):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Watts; a Watts Water Technologies company.
 - e. Woodford Manufacturing Company.
 - f. Zurn Industries, LLC.
 - 2. Basis of Design: Woodford 26.
 - 3. Standard: ASME A112.18.1 for sediment faucets.
 - 4. Body Material: Bronze.
 - 5. Seat: Bronze, replaceable.
 - 6. Supply Connections: NPS 3/4 threaded or solder-joint inlet.
 - 7. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
 - 8. Pressure Rating: 125 psig.
 - 9. Vacuum Breaker: Integral non-removable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
 - 10. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
 - 11. Finish for Service and Exterior Areas: Chrome or nickel plated.
 - 12. Finish for Finished Rooms: Chrome or nickel plated.
 - 13. Operation for Equipment Rooms: Metal wheel handle.
 - 14. Operation for Service and Exterior Areas: Operating key.
 - 15. Operation for Finished Rooms: Operating key.
 - 16. Include operating key with each operating-key hose bibb.
 - 17. Include wall flange with each chrome- or nickel-plated hose bibb.

2.10 WALL AND ROOF HYDRANTS

- A. Non-freeze Wall Hydrants Concealed (WH-1):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Watts; a Watts Water Technologies company.
 - e. Woodford Manufacturing Company.
 - f. Zurn Industries, LLC.

- 2. Basis of Design: Woodford B67.
- 3. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
- 4. Pressure Rating: 125 psig.
- 5. Operation: Loose key.
- 6. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
- 7. Inlet: NPS 3/4 or NPS 1.
- 8. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7. Automatic draining with hose attached.
- 9. Box: Deep, flush mounted with cover.
- 10. Box and Cover Finish: Polished nickel bronze or chrome plated.
- 11. Nozzle and Wall-Plate Finish: Polished nickel bronze or chrome-plated.
- 12. Operating Keys(s): One with each wall hydrant.
- B. Conditioned Space Wall Hydrants Exposed (WH-2):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Watts; a Watts Water Technologies company.
 - e. Woodford Manufacturing Company.
 - f. Zurn Industries, LLC.
 - 2. Basis of Design: Woodford 79.
 - 3. Standard: ASME A112.21.3M for exposed-outlet, self-draining wall hydrants.
 - 4. Pressure Rating: 125 psig.
 - 5. Operation: Loose key.
 - 6. Inlet: NPS 3/4 or NPS 1.
 - 7. Outlet:
 - a. Exposed, with integral vacuum breaker or nonremovable hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052. Automatic draining with hose attached.
 - b. Garden-hose thread complying with ASME B1.20.7.
 - 8. Nozzle and Wall-Plate Finish: Polished nickel bronze or chrome-plated.
 - 9. Operating Key(s): One with each wall hydrant.
- C. Non-Freeze Draining-Type Roof Hydrants (RH-1):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Watts; a Watts Water Technologies company.
 - e. Woodford Manufacturing Company.
 - f. Zurn Industries, LLC.
 - 2. Basis of Design: Jay R. Smith Mfg. Co. 5906.
 - 3. Standard: ASME A112.21.3M.
 - 4. Type: Non-freeze, exposed-outlet roof hydrant with coated cast-iron head, pail hook, and lift handle with lock option. Provide with deck flange/flashing clamp and under deck clamp.
 - 5. Casing and Operating Rod: Bronze interior parts, galvanized-steel casing, plunger valve, and drain.
 - 6. Inlet: NPS 3/4.
 - 7. Outlet: Garden-hose thread complying with ASME B1.20.7.

2.11 DRAIN VALVES

- A. Ball-Valve-Type, Hose-End Drain Valves:
 - 1. Standard: MSS SP-110 for standard-port, two-piece ball valves.

- 2. Pressure Rating: 400-psig minimum CWP.
- 3. Size: NPS 3/4.
- 4. Body: Copper alloy.
- 5. Ball: Chrome-plated brass.
- 6. Seats and Seals: Replaceable.
- 7. Handle: Vinyl-covered steel.
- 8. Inlet: Threaded or solder joint.
- 9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with seal and brass chain.

2.12 WATER HAMMER ARRESTERS

- A. Water-Hammer Arresters:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Precision Plumbing Products.
 - e. Watts; a Watts Water Technologies company.
 - f. Zurn Industries, LLC.
 - 2. Standard: ASSE 1010 or PDI-WH 201.
 - 3. Type: Copper tube with piston, factory pressurized and sealed.
 - 4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.13 TRAP SEAL PRIMER SYSTEMS

- A. Trap-Seal Primer Quad Outlet (TPA):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Mifab.
 - b. Precision Plumbing Products.
 - c. Zurn Industries, LLC.
 - 2. Standard: ASSE 1044.
 - 3. Description: Electronic trap primer array with adjustable frequency and duration settings. Mounted in box with cover, inlet connection, solenoid valve, air gap fitting, copper internal piping, and four-port manifold.
 - 4. Inlet Size: NPS 1/2.
 - 5. Cabinet: Steel box with stainless-steel cover.
 - a. Surface mounted: Mechanical rooms and service spaces.
 - b. Recessed-mounted: Restrooms.
 - 6. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
 - 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.
 - 7. Size Outlets: NPS 1/2.
- B. Trap-Seal Primer Arrays (TPA):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co.
 - b. Mifab.
 - c. Precision Plumbing Products.
 - d. Zurn Industries, LLC.
 - 2. Standard: ASSE 1044.
 - 3. Description: Electronic trap primer array with adjustable frequency and duration settings. Mounted in box with cover, inlet connection, full-port ball-type shut-off valve, wye strainer, transformer, copper internal piping, and multi-port manifold.
 - 4. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.

- 5. Cabinet: Steel box with stainless-steel cover.
 - a. Surface mounted: Mechanical rooms and service spaces.
 - b. Recessed-mounted: Restrooms.
- 6. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
 - 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.
- 7. Vacuum Breaker: ASSE 1001.
- 8. Number of trap primers and number of outlets as required to serve all building trap primer connections.
- 9. Size Outlets: NPS 1/2.

2.14 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flex-Hose Co., Inc.
 - 2. Flexicraft Industries.
 - 3. Metraflex Company (The).
 - 4. Universal Metal Hose.
- B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig.
 - 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
 - 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainlesssteel wire-braid covering and ends welded to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig.
 - 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
 - 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 - 1. Locate backflow preventers in same room as connected equipment or system.
 - 2. Install drain for backflow preventers with atmospheric-vent drain connection with airgap fitting, fixed airgap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.
- B. Install balancing valves in locations where they can easily be adjusted.
- C. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- D. Install -pattern strainers for water on supply side of each control valve water pressurereducing valve, solenoid valve, and pump.
- E. Unless otherwise noted, install expansion tanks on concrete bases, level and plumb, firmly anchored. Arrange so devices needing servicing are accessible.
 - 1. Anchor tank supports and tanks to substrate.
 - 2. After installing tanks with factory finish, inspect finishes and repair damages to finishes.
 - 3. Install piping adjacent to potable-water tanks to allow service and maintenance.
 - 4. Connect water piping to potable water tanks with unions or flanges.

- a. Shutoff Valves: Provide shutoff valves at water piping connections to potable water storage tanks. Shutoff valves for expansion tanks shall be normally-open, lockable valves.
- b. Water Piping Connections: Make connections to dissimilar metals with dielectric fittings.
- F. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fireretardant-treated-wood blocking, wall reinforcement between studs.
- G. Install water-hammer arresters in water piping according to PDI-WH 201.
- H. Trap-seal Primers:
 - 1. Provide individual supply piping from each trap-seal primer device outlet to each trap primer connection.
 - 2. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Provide equipment schedules on inside cover of each trap-seal primer system detailing location of each trap primer connection served in accordance with section 22 05 53 Identification for Plumbing Piping and Equipment.

3.02 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Test each reduced-pressure-principle backflow preventer and double-check backflowprevention assembly according to authorities having jurisdiction and the device's reference standard.
 - 2. Verify that air precharge in precharged expansion tanks is correct.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.03 AD USTING

- A. Set field-adjustable flow set points of balancing valves.
- B. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.
- C. Set field-adjustable trap-seal primer systems injection times to provide flow to the most remote drains served by each system.

END OF SECTION

SECTION 22 1123

DOMESTIC WATER PUMPS

PART 1 GENERAL

1.01 DEFINITIONS

- A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- B. PID: Proportional Integral Derivative.
- C. VFD: Variable-Frequency Drive.
- D. ECM: Electronically Commutated Motor.

1.02 ACTION SUBMITTALS

- A. Provide submittals for products listed in the Product Table below in accordance with Section 22 05 00 – General Plumbing Provisions. Submittal requirements indicated by column number designation as follows:
 - 1. Materials List
 - 2. Catalog Data
 - 3. Product Data
 - 4. Performance Data
 - 5. Wiring Diagrams
 - 6. Shop Drawings
 - 7. Installation Instructions
 - 8. Special Requirement listed herein

PRODUCT TABLE	1	2	3	4	5	6	7	8
In-Line, Seal-less Centrifugal Pumps								
Horizontally Mounted, In-Line, Separately								
Coupled Centrifugal Pumps								
Multiplex, Variable-Speed Booster Pumps								
Controls								

- B. Special Requirements:
 - 1. Booster Pump Shop Drawings:
 - a. Include plans, elevations, sections, and mounting or attachment details.
 - b. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - c. Include diagrams for power, signal, and control wiring.
 - 2. Booster Pump Delegated-Design Submittal:
 - a. Include design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

1.03 INFORMATIONAL SUBMITTALS

A. Field quality-control reports

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.
- C. Pump and motor combination shall operate at specified system fluid temperatures without vapor binding or cavitation and are non-overloading in parallel or individual operation.

D. Pumps shall conform to ANSI/HI 9.6.1-1997 standards for Centrifugal and Vertical Pumps for NPSH margin.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written rigging instructions for handling.

1.07 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 PRODUCTS

2.01 IN LINE, SEALLESS CENTRIFUGAL PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Bell & Gossett.
 - 2. Grundfos Pumps Corp.
 - 3. TACO Comfort Solutions, Inc.
- B. Description: Factory-assembled and tested, in-line, close-coupled, canned-motor, sealless, overhung-impeller centrifugal pumps.
- C. Pump Construction:
 - 1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
 - 2. Casing: Lead-free bronze, with threaded or companion-flange connections.
 - 3. Impeller: Plastic, lead-free bronze, or stainless steel.
 - 4. Motor: Single speed, unless otherwise indicated.

2.02 MULTIPLEX, VARIABLE SPEED BOOSTER PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Armstrong Pumps, Inc.
 - 2. Bell & Gossett; a ylem brand.
 - 3. Flowtherm Systems.
 - 4. Goulds Water Technology; a ylem brand.
 - 5. Grundfos Pumps Corporation U.S.A.
 - 6. ITT Flowtronex
- B. Description: Factory-assembled and -tested, fluid-handling system for domestic water, with pumps, piping, valves, specialties, and controls, and mounted on base.
- C. Pumps:
 - 1. Type: Vertical, multistage as defined in HI 1.1-1.2 and HI 1.3 for in-line, multistage, separately coupled, overhung-impeller, centrifugal pump.
 - 2. Casing: Cast-iron or steel base and stainless-steel chamber.
 - 3. Impeller: Closed, stainless-steel; statically and dynamically balanced and keyed to shaft.
 - 4. Shaft: Stainless-steel.
 - 5. Seal: Mechanical.
 - 6. Bearing: Water-lubricated sleeve type.
- D. Motors: Single speed, with grease-lubricated or pre-greased, permanently shielded, ballbearings. Select motors that will not overload through full range of pump performance curve.
- E. Piping: Stainless-steel pipe and fittings.
- F. Valves:
 - 1. Shutoff Valves NPS 2 (DN 50) and Smaller: Two-piece, full-port ball valve, in each pump's suction and discharge piping.

- 2. Shutoff Valves NPS 2-1/2 (DN 65) and Larger: Gate valve or lug-type butterfly valve, in each pump's suction and discharge piping and in inlet and outlet headers.
- 3. Check Valves NPS 2 (DN 50) and Smaller: Silent type in each pump's discharge piping.
- 4. Check Valves NPS 2-1/2 (DN 65) and Larger: Silent type in each pump's discharge piping.
- 5. Thermal-Relief Valve: Temperature-and-pressure relief type in pump's discharge header piping.
- G. Dielectric Fittings: With insulating material to isolate joined dissimilar metals.
- H. VFD Serving Pump Array: Comply with requirements of Section 22 05 14 Motor Control Devices for Plumbing Equipment.
- I. Base: Structural steel.
- J. Capacities: As shown on drawings.
- K. Characteristics:
 - 1. Minimum Pressure Rating: 150 psig.
 - 2. Header Size: 2-1/2 NP.
- L. Control Panel: The pump package shall include a UL listed, factory wired control panel in a NEMA 1 enclosure with single point power connection and all necessary components for automatic operation of the pumps. The panel shall include:
 - 1. Main power disconnect.
 - 2. Control circuit transformer with fused secondary.
 - 3. Variable Frequency Drive.
 - 4. Through the door disconnect for each pump.
 - 5. H-O-A selector switch for each pump.
 - 6. Door Mounted Pump Status Lights shall include:
 - a. Pump Run.
 - b. Pump Out of Service.
 - c. General Alarm.
 - 7. Digital programmable logic controller.
 - 8. Audible General Fault Alarm. Includes a push to silence button and dry contacts wired to a terminal strip for remote monitoring. A general fault alarm shall occur upon a pump fault, VFD fault, PLC fault, transducer failure, high system pressure, low suction pressure, and overload. The PLC shall maintain a data log including a date and time stamp of the 20 most recent system and VFD faults, which shall be displayed on the door mounted display. Provide a dry contact for connection to the building automation system to communicate an alarm condition.
 - 9. The micro-processor based supervisory controller shall be a panel door mounted unit with graphic touch screen display. The controller shall include PID control functions and control the VFD's through a network interface. In addition to sending the run command and speed reference signal to the VFD's through the network interface, the controller shall display line voltage, output frequency, output current and fault conditions for each VFD. The controller shall provide an easy to use operator interface to all system parameters. Monitoring functions shall be available to all users, but access to parameters shall be restricted by a minimum of two levels of password protection.
 - 10. Control logic shall include proof of no demand shutdown, which tests the system demand and then shuts off the lead pump if no demand is proven. The lag pumps shall shut off when it operates at its minimum speed for an adjustable elapsed time. The control logic shall also include dynamic set point adjustment, which automatically lowers or increases the system discharge operating pressure set point as the system demand changes. Alternative designs that do not utilize a built in software algorithm to compensate for the variable friction losses shall not be allowed to have their pressure transducer mounted on the discharge header; instead their transducer shall be provided loose and installed at the furthest remote location of the system to account for the variable friction losses within the piping system. The controls shall automatically stage the pumps and adjust the pump speed based on discharge pressure control. The lead and lag pumps shall be rotated after each system shutdown. The controls shall start a lag pump on lead pump failure. A

high temperature safety shut down system shall be provided which uses a temperature sensor which measures the discharge water temperature and is directly connected to the PLC. If a high temperature occurs the system shall shut down and go into alarm. The pump water temperature monitoring must be used as a safety feature and cannot be used as an operating control. The controls shall include pump minimum run time and pump maximum run time adjustable set points.

- M. Source Quality Control:
 - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 - 2. ASME Compliance: Comply with ASME B31.9 for piping.
 - 3. UL Compliance for Packaged Pumping Systems:
 - a. UL 508, "Industrial Control Equipment."
 - b. UL 508A, "Industrial Control Panels."
 - c. UL 778, "Motor-Operated Water Pumps."
 - d. UL 1995, "Heating and Cooling Equipment."
 - 4. Booster pumps shall be listed and labeled as packaged pumping systems by testing agency acceptable to authorities having jurisdiction.

2.03 CONTROLS

- A. Thermostats: Electric; adjustable for control of hot-water circulation pump.
 - 1. Type: Water-immersion temperature sensor, for installation in piping.
 - 2. Operation of Pump: On or off.
 - 3. Transformer: Provide if required.
 - 4. Power Requirement: 120 V, ac.
 - 5. Settings: Start pump at 100 deg F and stop pump at 120 deg F.
- B. Timers: Electric, for control of hot-water circulation pump.
 - 1. Type: Programmable, clock with manual override on-off switch.
 - 2. Enclosure: NEMA 250, suitable for wall mounting.
 - 3. Operation of Pump: On or off.
 - 4. Transformer: Provide if required.
 - 5. Power Requirement: 120-V ac.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.02 PUMP INSTALLATION

- A. Comply with ANSI/HI 1.4 standard.
- B. Install in-line, sealless centrifugal pumps with shaft horizontal unless otherwise indicated.
- C. Booster-Pump Mounting:
 - 1. Install booster pumps on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Division 03.
 - 2. Support connected domestic water piping so weight of piping is not supported by booster pumps.
- D. Install continuous-thread hanger rods and spring hangers of size required to support hot water recirculation pump weight.
- E. Install pressure switches in water supply piping.
- F. Install thermostats in hot-water return piping.
- G. Install timers where indicated on drawings or in accessible location as close as possible to controlled pump(s).

3.03 DOMESTIC WATER PUMP CONNECTIONS

- A. Install piping adjacent to pumps to allow service and maintenance.
- B. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
 - 1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
 - a. Horizontally mounted, in-line, close-coupled centrifugal pumps.
- C. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping.
 - 1. Install pressure gauge at suction of each pump and pressure gauge at discharge of each pump. Install at integral pressure-gauge tappings where provided or install pressure-gauge connectors in suction and discharge piping around pumps.
- D. Connect thermostats and timers to pumps that they control.
- E. Connect wiring, ground equipment, and install electrical devices furnished by the manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
- F. Install control and electrical power wiring to field-mounted control devices and connect control wiring.

3.04 DOMESTIC WATER BOOSTER PUMP CONNECTIONS

- A. Connect domestic water piping to booster pumps. Install suction and discharge piping equal to or greater than size of system suction and discharge headers.
 - 1. Install shutoff valves on piping connections to booster-pump suction and discharge headers. Install ball, butterfly, or gate valves same size as suction and discharge headers.
 - 2. Install union, flanged, or grooved-joint connections on suction and discharge headers at connection to domestic-water piping.
 - 3. Install valved bypass, same size as and between piping, at connections to booster-pump suction and discharge headers.
 - 4. Install flexible connectors, same size as piping, on piping connections to booster-pump suction and discharge headers.
 - 5. Where installing piping adjacent to booster pumps, allow space for service and maintenance.
- B. Connect wiring, ground equipment, and install electrical devices furnished by the manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
- C. Install control and electrical power wiring to field-mounted control devices and connect control wiring.

3.05 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
 - 1. Perform visual and mechanical inspection.
 - 2. Leak Test: After installation, charge booster pump and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start booster pumps to confirm proper motor rotation and booster-pump operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Pumps and controls will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.06 STARTUP SERVICE

- A. Perform startup service for domestic water circulation pumps.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

- 2. Check piping connections for tightness.
- 3. Clean strainers on suction piping.
- 4. Set thermostats and time controls for automatic starting and stopping operation of pumps.
- 5. Perform the following startup checks for each pump before starting:
 - a. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - b. Verify that pump is rotating in the correct direction.
- 6. Prime pump by opening suction valves and closing drains and prepare pump for operation.
- 7. Start motor.
- 8. Open discharge valve slowly.
- 9. Adjust temperature settings on thermostats.
- B. Engage a factory-authorized service representative to perform startup service for domestic water booster pumps.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Clean strainers on suction piping.
 - 3. Set pressure switches and time settings for automatic starting and stopping operation of pumps.
 - 4. Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.
 - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - c. Verify that pump is rotating in the correct direction.
 - 5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
 - 6. Start motor.
 - 7. Open discharge valve slowly.
 - 8. Adjust temperature settings on thermostats.
 - 9. Adjust timer settings.

3.07 AD USTING

- A. Adjust domestic water pumps to function smoothly and lubricate as recommended by manufacturer.
- B. Adjust initial temperature set points.
- C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- D. Adjust booster pump pressure set points.
- E. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting booster pump to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.08 DEMONSTRATION AND TRAINING

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

END OF SECTION

SECTION 22 1316

SANITARY WASTE, VENT, AND STORM DRAIN PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes pipe, fittings, and joining methods for sanitary waste, vent and storm drain piping.

1.02 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: 50 psig.

1.03 ACTION SUBMITTALS

- A. Provide materials list for pipe and fittings.
- B. Provide catalog data for dielectric fittings.

1.04 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 PRODUCTS

2.01 PIPING MATERIALS

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

2.02 HUBLESS, CAST IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
 - 1. Standards: ASTM C 1277 and CISPI 310.
 - 2. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.03 GALVANIZED STEEL PIPE AND FITTINGS

- A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Standard Weight class. Include square-cutgrooved 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-andsocket, 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.

2.04 COPPER TUBE AND FITTINGS

- A. Copper Type DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16. 23, cast copper or ASME B16. 29, wrought copper, solderjoint fittings.
- C. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.05 PVC PIPE AND FITTINGS

- A. Solid-Wall Schedule 80 PVC Pipe:
 - 1. Solid-Wall PVC Pipe: ASTM D 1785, drain, waste, and vent for pressure applications.
 - 2. PVC Socket Fittings: ASTM D 2467, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 80 pipe.
 - 3. Adhesive Primer: ASTM F 656.
 - 4. Solvent Cement: ASTM D 2564.
- B. Perforated, Belled-End PVC Pipe:
 - 1. Perforated, Belled-End PVC Pipe: ASTM D 2729, drain and sewer, two rows of 5/8-inch holes on 5-inch centers, 120 degrees spacing.
 - 2. Adhesive Primer: ASTM F 656.
 - 3. Solvent Cement: ASTM D 2564, 795 medium-bodied, fast setting low VOC PVC solvent cement.

2.06 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 - 1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
 - 2. Unshielded, Non-pressure Transition Couplings:
 - a. Standard: ASTM C 1173.
 - b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - c. End Connections: Same size as and compatible with pipes to be joined.
 - 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.
 - 3. Shielded, Non-pressure Transition Couplings:
 - a. Standard: ASTM C 1460.
 - b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - c. End Connections: Same size as and compatible with pipes to be joined.
 - Pressure Transition Couplings:
 - a. Standard: AWWA C219.
 - b. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
 - c. Center-Sleeve Material: Carbon steel, stainless-steel, ductile iron, or malleable iron.
 - d. Gasket Material: Natural or synthetic rubber.
 - e. Metal Component Finish: Corrosion-resistant coating or material.

PART 3 EXECUTION

4.

3.01 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31.

3.02 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved by Engineer.
- 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. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
 - 1. 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.
 - 2. Use long-turn, double -branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
 - a. Straight tees, elbows, and crosses may be used on vent lines.
 - 3. Do not change direction of flow more than 90 degrees.
 - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Do not reduce size of waste piping in direction of flow.
- J. Lay buried building waste piping beginning at low point of each system.
 - 1. Install true to grades and alignment indicated, with unbroken continuity of invert.
 - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 - 3. Maintain swab in piping and pull past each joint as completed.
- K. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Sanitary Waste: 2 percent downward in direction of flow for piping NPS 3 and smaller.
 - 2. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- L. 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."
- M. Install steel piping according to applicable plumbing code.
- N. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- O. Install aboveground PVC piping according to ASTM D 2665.
- P. Install underground PVC piping according to ASTM D 2321.
- Q. Plumbing Specialties:
 - 1. Install cleanouts at grade where shown on drawings. Provide a cleanout to exterior grade wherever sanitary or storm drain piping leaves the building.
 - 2. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
- R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- S. Install sleeves for piping penetrations of walls, ceilings, and floors.

3.03 OINT CONSTRUCTION

- A. 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.
- B. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1. 20. 1.
 - 1. Cut threads full and clean using sharp dies.
 - 2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
 - c. Do not use pipe sections that have cracked or open welds.
- C. 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.

D. 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.

3.04 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in ODs.
 - 2. In Waste Drainage Piping: Non-pressure transition couplings. Shielded below grade. Unshielded above grade.
 - 3. In Aboveground Force Main Piping: Fitting-type transition couplings.
 - 4. In Underground Force Main Piping: Pressure transition couplings.

3.05 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 22 05 29 Hangers and Supports for Plumbing Piping and Equipment.
- B. Support vertical piping and tubing at base and at each floor.

3.06 CONNECTIONS

- A. Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
- B. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- C. 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.

3.07 FIELD QUALITY CONTROL

- A. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Test sanitary waste 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.
 - a. 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 waste and vent piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
 - a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
 - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
 - c. 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.
 - a. 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.
 - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
 - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
 - d. 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.
- C. 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.
 - a. 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.
 - a. Isolate test source and allow to stand for four hours.
 - b. 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.

3.08 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.09 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. All sanitary waste, storm water, and underground vent piping shall be any of the following:
 - 1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
 - 2. Hard copper tube, Type DWV; cast or wrought-copper fittings; and soldered joints.
 - 3. Dissimilar Pipe-Material Couplings: Non-pressure transition couplings.
- C. Aboveground, vent piping shall be any of the following:
 - 1. Galvanized-steel pipe, drainage fittings, and threaded joints.
 - 2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
 - 3. Hard copper tube, Type DWV; cast or wrought-copper fittings; and soldered joints.
 - 4. Dissimilar Pipe-Material Couplings: Unshielded, Non-pressure transition couplings.
- D. Aboveground sanitary-sewage force mains shall be any of the following:
 - 1. Galvanized-steel pipe, pressure fittings, and threaded joints.
 - 2. Solid-wall Schedule 80 PVC pipe, PVC socket fittings, and solvent-cemented joints.
- E. Underground sanitary-sewage force mains NPS 2 and smaller shall be any of the following:
 - 1. Hard copper tube, Type DWV; cast or wrought-copper pressure fittings; and soldered joints.
 - 2. Solid-wall Schedule 80 PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 3. Pressure transition coupling for NPS 1-1/2 and larger if dissimilar pipe materials.
- F. Sub-soil and foundation drainage piping shall be the following:
 - 1. Perforated, belled-end PVC pipe with solvent-cemented joints.
 - 2. Dissimilar Pipe-Material Couplings: Non-pressure transition couplings.

SANITARY WASTE PIPING SPECIALTIES

PART 1 GENERAL

1.01 ACTION SUBMITTALS

- A. Provide submittals for products listed in the Product Table below in accordance with Section 22 05 00 – General Plumbing Provisions. Submittal requirements indicated by column number designation as follows:
 - 1. Materials List
 - 2. Catalog Data
 - 3. Product Data
 - 4. Performance Data
 - 5. Wiring Diagrams
 - 6. Shop Drawings
 - 7. Installation Instructions
 - 8. Special Requirement listed herein.
 - 9.

PRODUCT TABLE	1	2	3	4	5	6	7	8
All Products in this Section								

1.02 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.03 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 PRODUCTS

2.01 ASSEMBLY DESCRIPTIONS

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary waste piping specialty components.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing, and marked for intended location and application.

2.02 FLOOR DRAINS AND DECK DRAINS

- A. Cast-Iron Floor Drains (FD-1):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co; a division of Morris Group International.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Sioux Chief Manufacturing Company, Inc.
 - e. WATTS.
 - f. Zurn Industries, LLC.
 - 2. Standard: ASME A112.6.3.
 - 3. Pattern: Floor drain with adjustable strainer.
 - 4. Body Material: Gray iron.
 - 5. Seepage Flange: Required.
 - 6. Anchor Flange: Required.
 - 7. Clamping Device: Required.
 - 8. Outlet: Bottom.
 - 9. Coating on Interior and Exposed Exterior Surfaces: Not required.
 - 10. Sediment Bucket: Not required.
 - 11. Top or Strainer Material: Nickel bronze.

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- 12. Top of Body and Strainer Finish: Nickel bronze.
- 13. Top Shape:
 - a. Areas with Tile Floors: Square.
 - All Other Floor Finishes: Round. b.
- 14. Strainer Free Area: A minimum of one and one-half times the cross-sectional area of the connected drain or sanitary waste piping.
- 15. Top Loading Classification: Light Duty.
- 16. Funnel: Not required.
- 17. Trap Material: Cast iron.
- 18. Trap Pattern: Standard P-trap.
- 19. Trap Features: Trap-seal primer valve drain connection.
- Cast-Iron Floor Drains (FD-2): B.
 - Manufacturers: Subject to compliance with requirements, provide products by one of the 1. following:
 - a. Jay R. Smith Mfg. Co; a division of Morris Group International.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Sioux Chief Manufacturing Company, Inc.
 - WATTS. e.
 - Zurn Industries, LLC. f.
 - 2. Standard: ASME A112.6.3.
 - 3. Pattern: Floor drain with adjustable strainer.
 - Body Material: Gray iron. 4.
 - Seepage Flange: Required. 5.
 - Anchor Flange: Required. 6.
 - Clamping Device: Required. 7.
 - Outlet: Bottom. 8.
 - Coating on Interior and Exposed Exterior Surfaces: Not required. 9.
 - 10. Sediment Bucket: Not required.
 - 11. Top or Strainer Material: Nickel bronze.
 - 12. Top of Body and Strainer Finish: Nickel bronze.
 - 13. Top Shape:
 - a. Areas with Tile Floors: Square.
 - All Other Floor Finishes: Round. b.
 - 14. Strainer Free Area: A minimum of one and one-half times the cross-sectional area of the connected drain or sanitary waste piping.
 - 15. Top Loading Classification: Light Duty.
 - 16. Funnel: Not required.
 - 17. Trap Material: Cast iron.
 - 18. Trap Pattern: Standard P-trap.
 - 19. Trap Features: Trap-seal primer valve drain connection.
- C. Cast-Iron Deck Drains (DD-1):
 - Manufacturers: Subject to compliance with requirements, provide products by one of the 1. following:
 - a. Jay R. Smith Mfg. Co; a division of Morris Group International.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - Sioux Chief Manufacturing Company, Inc. d.
 - WATTS. e.
 - Zurn Industries, LLC. f.
 - 2. Basis of Design: WATTS FD-930.
 - Standard: ASME A112.21.1M. 3.
 - 4. Pattern: Deck drain with countersunk deck flange.
 - Body Material: Cast iron. 5.
 - Seepage Flange: Not required. 6.

- 7. Anchor Flange: Required.
- 8. Clamping Device: Required.
- 9. Outlet: Bottom.
- 10. Coating on Interior and Exposed Exterior Surfaces: Not required.
- 11. Sediment Bucket: Not required.
- 12. Top or Strainer Material: Ductile iron.
- 13. Top of Body and Strainer Finish: Epoxy coating.
- 14. Top Shape: Square.
- 15. Strainer Size: Minimum 15-inches by 15-inches square.
- 16. Strainer Free Area: 79 square inches.
- 17. Top Loading Classification: Extra heavy duty, safe live load 7500-10000 lbs.

2.03 FLOOR SINKS

- A. Cast-Iron Floor Sinks (FS-1):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co; a division of Morris Group International.
 - b. Josam Company.
 - c. WATTS.
 - d. Zurn Industries, LLC.
 - 2. Standard: ASME A112.6.7.
 - 3. Pattern: Floor drain.
 - 4. Body Material: Cast iron.
 - 5. Anchor Flange: Required, with seepage holes.
 - 6. Clamping Device: Required.
 - 7. Outlet: Bottom, no-hub connection.
 - 8. Coating on Interior Surfaces: Acid-resistant enamel.
 - 9. Sediment Bucket: Not required.
 - 10. Internal Strainer: Dome.
 - 11. Internal Strainer Material: Aluminum.
 - 12. Top Grate Material: Nickel bronze top, loose.
 - 13. Top of Body and Grate Finish: Nickel bronze.
 - 14. Top Shape: Square, half grate.
 - 15. Dimensions of Top Grate: 12-inches by 12-inches square.
 - 16. Dimensions of Body: 14-inches by 14-inches square flange, 6-inches deep.
 - 17. Top Loading Classification: No traffic.
 - 18. Funnel: Not required.
 - 19. Trap Material: Cast iron.
 - 20. Trap Pattern: Deep-seal P-trap.
 - 21. Trap Features: Trap-seal primer valve drain connection.
- B. Cast-Iron Floor Sinks (FS-2):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co; a division of Morris Group International.
 - b. Josam Company.
 - c. WATTS.
 - d. Zurn Industries, LLC.
 - 2. Standard: ASME A112.6.7.
 - 3. Pattern: Floor drain.
 - 4. Body Material: Cast iron.
 - 5. Anchor Flange: Required, with seepage holes.
 - 6. Clamping Device: Required.
 - 7. Outlet: Bottom, no-hub connection.
 - 8. Coating on Interior Surfaces: Acid-resistant enamel.
 - 9. Sediment Bucket: Not required.
 - 10. Internal Strainer: Dome.

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- 11. Internal Strainer Material: Aluminum.
- 12. Top Grate Material: Nickel bronze top, loose.
- 13. Top of Body and Grate Finish: Nickel bronze.
- 14. Top Shape: Square, 3/4 grate.
- 15. Dimensions of Top Grate: 12-inches by 12-inches square.
- 16. Dimensions of Body: 14-inches by 14-inches square flange, 6-inches deep.
- 17. Top Loading Classification: No traffic.
- 18. Funnel: Not required.
- 19. Trap Material: Cast iron.
- 20. Trap Pattern: Deep-seal P-trap.
- 21. Trap Features: Trap-seal primer valve drain connection.

2.04 CLEANOUTS

- A. Cast-Iron Exposed Cleanouts (COTG):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Sioux Chief Manufacturing Company, Inc.
 - e. Watts; a Watts Water Technologies company.
 - f. Zurn Industries, LLC.
 - 2. Standard: ASME A112.36.2M.
 - 3. Size: Same as connected drainage piping
 - 4. Body Material: Hubless, cast-iron soil pipe.
 - 5. Closure: Countersunk or raised-head, brass plug.
 - 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- B. Cast-Iron Exposed Floor Cleanouts (FCO):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Company.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Watts; a Watts Water Technologies company.
 - e. Zurn Industries, LLC.
 - 2. Basis of Design: Jay R. Smith Mfg. Co. Figure 4020.
 - 3. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
 - 4. Size: Same as connected branch.
 - 5. Type: Threaded, adjustable housing.
 - 6. Body or Ferrule: Cast iron.
 - 7. Clamping Device: Not required.
 - 8. Carpet Marker: Where cleanout is located in areas with carpeted flooring or where shown on drawings.
 - 9. Outlet Connection: Inside caulk or hubless.
 - 10. Closure: Brass plug with straight threads and gasket or brass plug with tapered threads.
 - 11. Adjustable Housing Material: Cast iron with threads.
 - 12. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
 - 13. Frame and Cover Shape: Round.
 - 14. Top Loading Classification: Light Duty.
 - 15. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
- C. Cast-Iron Wall Cleanouts (WCO):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Company.

- c. MIFAB, Inc.
- d. Watts; a Watts Water Technologies company.
- e. Zurn Industries, LLC.
- 2. Standard: ASME A112.36.2M. Include wall access.
- 3. Size: Same as connected drainage piping.
- 4. Body: Hubless, cast-iron soil pipe.
- 5. Closure Plug:
 - a. Brass.
 - b. Countersunk or raised head.
 - c. Drilled and threaded for cover attachment screw.
 - d. Size: Same as or not more than one size smaller than cleanout size.
- 6. Wall Access: Round, flat, stainless-steel cover plate with screw.

2.05 ROOF FLASHING ASSEMBLIES

- A. Roof Flashing Assemblies:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company.
 - b. Thaler Metal Industries Ltd.
 - c. Zurn Industries, LLC.
 - 2. Description: Manufactured assembly made of 6.0-lb/sq. ft., 0.0938-inch-thick, lead flashing collar and skirt extending at least 10 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
 - a. Open-Top Vent Cap: Without cap.

2.06 THROUGH PENETRATION FIRESTOP ASSEMBLIES

A. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 22 05 00
 - General Plumbing Provisions.

2.07 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

- A. Hub Drains:
 - 1. Description: Shop or field fabricate from ASTM A 74, Service class, cast-iron soil-pipe fittings. Hub drains may be constructed of either hub-and-spigot piping or hubless piping with concentric reducer fittings. Include P-trap with primer connection, riser section; and where required, increaser fitting joined with ASTM C 564 rubber gaskets.
 - 2. Size: Same as connected waste piping.
- B. Trap-Seal Primer Fittings:
 - 1. Description: Material to match floor drain or floor sink p-trap, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
 - 2. Size: Same as floor drain or floor sink outlet with NPS 1/2 side inlet.
- C. 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.
- D. 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.

- E. 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.
- F. Expansion Joints:
 - 1. Standard: ASME A112.6.4.
 - 2. Body: Cast iron with bronze sleeve, packing, and gland.
 - 3. End Connections: Matching connected piping.
 - 4. Size: Same as connected soil, waste, or vent piping.

PART 3 EXECUTION

3.01 INSTALLATION

- A. 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.
 - 3. 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.
 - 4. Install floor-drain and floor sink flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
 - a. Maintain integrity of waterproof membranes where penetrated.
 - 5. Install individual traps for floor drains and floor sinks connected to sanitary building drain, unless otherwise indicated.
- 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 horizontal change in direction of piping greater than 135 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 3 and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack or vertical storm piping conductor.
- 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 at a minimum height of 12-inches, of types indicated, with frame and cover flush with finished wall.
- E. Install roof flashing assemblies or flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- F. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
- G. Assemble hub drain fittings and install with top of hub a minimum of 2 inches above floor unless otherwise indicated.
- H. Install trap-seal primer fittings on inlet to floor drains and floor sinks that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if the trap or drain fixture has a trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- I. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

- J. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- K. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- L. Install wood-blocking reinforcement for wall-mounting-type specialties.
- M. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.02 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required.
- 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 Division 07.
- 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. 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.

3.03 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.

SANITARY SEWAGE AND STORMWATER PUMPS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Submersible sump pumps.
 - 2. Sump-pump shutoff and check valves.

1.02 ACTION SUBMITTALS

- A. Provide submittals for products listed in the Product Table below in accordance with Section 22 05 00 – General Plumbing Provisions. Submittal indicated by column number designation as follows
 - 1. Materials List
 - 2. Catalog Data
 - 3. Product Data
 - 4. Performance Data
 - 5. Wiring Diagrams
 - 6. Shop Drawings
 - 7. Installation Instructions
 - 8. Special Requirement listed herein

PRODUCT TABLE	1	2	3	4	5	6	7	8
Submersible Sump Pumps								

PART 2 PRODUCTS

2.01 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.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

2.02 SUBMERSIBLE SUMP PUMPS

- A. Submersible, Fixed-Position, Single-Seal Sump Pumps (SP-1):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. Bell & Gossett; a ylem brand.
 - b. Goulds Water Technology; a ylem brand.
 - c. Grundfos Pumps Corp.
 - d. Liberty Pumps.
 - e. Weil.
 - f. Zoeller Company.
 - 2. Basis of Design: Liberty 283.
 - 3. Description: Factory-assembled and -tested sump-pump unit.
 - 4. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal effluent pump as defined in Hydraulics Institute (HI) 1.1-1.2 and HI 1.3.
 - 5. Pump Casing: Cast iron, with open inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
 - 6. Impeller: Statically and dynamically balanced, closed or semi-open design for clear wastewater, and keyed and secured to shaft.
 - 7. Pump and Motor Shaft: Stainless-steel, with factory-sealed, grease-lubricated ball bearings.
 - 8. Seal: Mechanical.
 - 9. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.

- 10. Controls:
 - a. Switch Type: Mechanical-float type.

2.03 SEWAGE AND SUMP PUMP SHUTOFF AND CHECK VALVES

- A. Description: Line-size check and isolation valves specified in Section 22 05 23 Valves for Plumbing Piping, provided Hereunder.
- B. Components: Include the following corrosion-resistant-metal components:
 - 1. Simplex Pumps:
 - a. Valves: One shutoff valve and one check valve.
 - b. Pipe and Fittings: Size and configuration required to connect to sump pumps and piping.

2.04 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 22 05 13 - 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
- B. Motors for submersible pumps shall be hermetically sealed.

PART 3 EXECUTION

3.01 EARTHWORK

A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31 - Earthwork.

3.02 EXAMINATION

- A. Examine roughing-in for plumbing piping to verify actual locations of sanitary drainage and vent piping connections before sewage pump installation
- B. Examine pumps before installation. Reject pumps that are damaged.

3.03 INSTALLATION

- A. Pump Installation Standards:
 - 1. Comply with HI 1.4 for installation of centrifugal pumps.

3.04 CONNECTIONS

- A. Where installing piping adjacent to equipment, allow space for service and maintenance.
- B. Connect piping to pumps. Install valves that are the same size as piping.
- C. Install shutoff and check valves on pump discharges.

3.05 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Perform each visual and mechanical inspection.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Tests: Required tests shall include but not be limited to the following:
 - a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Take amperage reading and turn off immediately if above nameplate value and report to the Engineer.
 - b. Level Switch Operation: Test fill receiver basin to confirm proper on/off operation of pump(s) and level switch(es). Confirm level switch(es) operate pump(s) correctly based on water level.
 - c. Confirm level switch(es) operate freely without binding or catching on obstructions.
 - 4. Replace damaged and malfunctioning controls and equipment.
- B. Pumps and controls will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.06 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions and perform the following.
 - 2. Remove debris from receiver basins and sumps.
 - 3. Verify that accessory items are properly installed.
 - 4. Check piping connections for tightness.
 - 5. Confirm that water level in the receiver is above the pump minimum submergence level prior to starting pump(s).

3.07 AD USTING

- A. Adjust pumps to function smoothly and lubricate as recommended by manufacturer.
- B. Adjust control set points.

STORM DRAINAGE PIPING SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Metal roof drains.
 - 2. Miscellaneous storm drainage piping specialties.
 - 3. Cleanouts.

1.02 ACTION SUBMITTALS

- A. Provide submittals for products listed in the Product Table below in accordance with Section 22 05 00 – General Plumbing Provisions. Submittal requirements indicated by column number designation as follows:
 - 1. Materials List
 - 2. Catalog Data
 - 3. Product Data
 - 4. Performance Data
 - 5. Wiring Diagrams
 - 6. Shop Drawings
 - 7. Installation Instructions
 - 8. Special Requirement listed herein.

PRODUCT TABLE	1	2	3	4	5	6	7	8
All Products in this Section								

1.03 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For storm drainage piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 PRODUCTS

2.

2.01 METAL ROOF DRAINS

- A. Cast-Iron, Large-Sump, General-Purpose Combination Roof and Overflow Drains (RD-1):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Company.
 - c. Marathon Roofing Products.
 - d. MIFAB, Inc.
 - e. WATTS.
 - f. Zurn Industries, LLC.
 - Basis of Design: Jay R. Smith Mfg. Co. number 1800.
 - 3. Standard: ASME A112.6.4.
 - 4. Body Material: Cast iron.
 - 5. Dimension of Body: Nominal 14-to 16-inch diameter.
 - 6. Flashing Ring: Required.
 - 7. Flow-Control Weirs: Not required.
 - 8. Outlet: Bottom.
 - 9. Outlet Type: No hub or inside caulk.
 - 10. Extension Collars: As required.
 - 11. Underdeck Clamp: Required.
 - 12. Expansion Joint: Not required.
 - 13. Combination Drain Mounting Plate: Required.
 - 14. Dome Material: Cast iron.
 - 15. Vandal-Proof Dome: Not required.

2.02 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

- A. Conductor Nozzles (DSN-1):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. WATTS.
 - e. Zurn Industries, LLC.
 - 2. Basis of Design: Jay R. Smith Mfg. Co number 1770.
 - 3. Nickel-bronze body with threaded or no-hub inlet and decorative nickel-bronze wall flange with mounting holes, cow's-tongue type outlet. Minimum 3-1/2-inch projection from surface of wall.
 - 4. Size: Same as connected conductor.
- B. Conductor Nozzles Concealed (DSC-1):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. WATTS.
 - e. Zurn Industries, LLC.
 - 2. Basis of Design: Jay R. Smith Mfg. Co. number 1775.
 - 3. Nickel-bronze or stainless-steel low-profile body with threaded or no-hub inlet, perforated hinged cover, and wall flange with mounting holes. Maximum 2-1/2-inch projection from surface of wall.
 - 4. Size: Same as connected conductor.

2.03 CLEANOUTS

- A. Cast-Iron Exposed Cleanouts (COTG):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Watts; a Watts Water Technologies company.
 - e. Zurn Industries, LLC.
 - 2. Standard: ASME A112.36.2M.
 - 3. Size: Same as connected drainage piping
 - 4. Cover: Painted, scoriated cast iron.
 - 5. Body Material: Hubless, cast-iron soil pipe test tee 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.
- B. Cast-Iron Exposed Floor Cleanouts (FCO):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Watts; a Watts Water Technologies company.
 - e. Zurn Industries, LLC.
 - 2. Standard: ASME A112.36.2M.
 - 3. Size: Same as connected drainage piping.
 - 4. Cover: Scoriated nickel-bronze.

- 5. Body Material: Hubless, cast-iron soil pipe test tee 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
- C. Cast-Iron Wall Cleanouts (WCO):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Watts; a Watts Water Technologies company.
 - e. Zurn Industries, LLC.
 - 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 Plug:
 - a. Brass.
 - b. Countersunk or raised head.
 - c. Drilled and threaded for cover attachment screw.
 - d. Size: Same as or not more than one size smaller than cleanout size.
 - Wall Access: Round, flat, stainless-steel cover plate with screw.
- D. Test Tees:

6.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Tyler Pipe; a subsidiary of McWane Inc.
 - e. WATTS.
 - f. Zurn Industries, LLC.
- 2. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301.
- 3. Size: Same as connected drainage piping.
- 4. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or no-hub, cast-iron soil-pipe test tee as required to match connected piping.
- 5. Closure Plug: Countersunk, brass.
- 6. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install roof drains at low points of roof areas in accordance with roof membrane manufacturer's written installation instructions.
 - 1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 - 2. Install expansion joints, if indicated, in roof drain outlets.
 - 3. Position roof drains for easy access and maintenance.
- B. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.
- C. Install cleanouts in aboveground piping and building drain piping in accordance with the following instructions unless otherwise indicated:
 - 1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate cleanouts at each change in direction of piping greater than 135 degrees.
 - 3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 3 and smaller and 100 feet for larger piping.
 - 4. Locate cleanouts at base of each vertical storm piping conductor.

- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install horizontal backwater valves in floor with cover flush with floor.
- G. Install test tees in vertical conductors and near floor.
- H. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

3.02 INSTALLATION OF FLASHING

- A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.

3.03 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.

FACILITY NATURAL GAS PIPING AND SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes pipe, fittings, and specialty equipment related to natural gas service.

1.02 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.03 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

- 1. Piping and Valves: 100 psig minimum unless otherwise indicated.
- B. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig but not more than 2 psig and is reduced to secondary pressure of 0.5 psig or less.

1.04 ACTION SUBMITTALS

- A. Provide submittals for products listed in the Product Table below in accordance with Section 22 05 00 – General Plumbing Provisions. Submittal requirements indicated by column number designation as follows:
 - 1. Materials List
 - 2. Catalog Data
 - 3. Product Data
 - 4. Performance Data
 - 5. Wiring Diagrams
 - 6. Shop Drawings
 - 7. Installation Instructions
 - 8. Special Requirement listed herein

PRODUCT TABLE	1	2	3	4	5	6	7	8
Pipes, Tubes, and Fittings								
Piping Specialties and Dielectric Fittings								
Manual Gas Shutoff Valves								
Pressure Regulators								
Seismic Shut-off Valves								
(Earthquake Shut-off Valves)								

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pressure regulators and seismic shut-off valves to include in emergency, operation, and maintenance manuals.

1.06 PRO ECT CONDITIONS

A. Gas service, utility meters, and regulating equipment to the inlet side of the meters will be installed by and costs paid by the natural gas utility company. Trench for the gas service piping provided by the utility will be coordinated with the Civil Engineer.

1.07 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces.

PART 2 PRODUCTS

2.01 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 - 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
 - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.

2.02 PIPING SPECIALTIES

- A. Appliance Flexible Connectors:
 - 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
 - 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
 - 3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
 - 4. Corrugated stainless-steel tubing with polymer coating.
 - 5. Operating-Pressure Rating: 0.5 psig.
 - 6. End Fittings: Zinc-coated steel.
 - 7. Threaded Ends: Comply with ASME B1.20.1.
- B. Maximum Length: 72 inches.
- C. -Pattern Strainers:
 - 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
 - 2. End Connections: Threaded ends for NPS 2and smaller; flanged ends for NPS 2-1/2and larger.
 - 3. Strainer Screen: 40-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
 - 4. CWP Rating: 125 psig.
- D. Weatherproof Vent Cap:
 - 1. Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.03 OINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

2.04 MANUAL GAS SHUTOFF VALVES

- A. General Requirements for Metallic Valves, NPS 2and Smaller: Comply with ASME B16.33.
 - 1. CWP Rating: 125 psig.
 - 2. Threaded Ends: Comply with ASME B1.20.1.
 - 3. Dryseal Pipe Threads on Flare Ends: Comply with ASME B1.20.3.
 - 4. Listing: Listed and labeled by a Nationally Recognized Testing Laboratory acceptable to authorities having jurisdiction for valves 1 inch and smaller.
 - 5. Service Mark: Valves 1-1/4 inches to NPS 2shall have initials "WOG" permanently marked on valve body.
- B. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A. . McDonald Mfg. Co.
 - b. BrassCraft Manufacturing Co., a Masco company
 - c. Apollo Valves
 - Body: Bronze, complying with ASTM B 584.
 - 3. Ball: Chrome-plated bronze.
 - 4. Stem: Bronze; blowout proof.

2.

- 5. Seats: Reinforced TFE; blowout proof.
- 6. Packing: Threaded-body packnut design with adjustable-stem packing.
- 7. Ends: Threaded or flanged to match piping.
- 8. CWP Rating: 600 psig.
- 9. Listing: Valves NPS 1and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.

2.05 PRESSURE REGULATORS

- A. General Requirements:
 - 1. Single stage and suitable for natural gas.
 - 2. Corrosion-resistant components.
 - 3. End Connections: Threaded for regulators NPS 2and smaller; flanged for regulators NPS 2-1/2and larger.
- B. Appliance Pressure Regulators: Comply with ANSI Z21.18.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton
 - b. Maxitrol Company
 - c. Pietro Fiorentini
 - 2. Body and Diaphragm Case: Die-cast aluminum.
 - 3. Springs: Zinc-plated steel; interchangeable.
 - 4. Diaphragm Plate: Zinc-plated steel.
 - 5. Seat Disc: Nitrile rubber.
 - 6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
 - 7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
 - 8. Regulator installed indoors may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
 - 9. Maximum Inlet Pressure: 2 psig.

2.06 SEISMIC SHUT OFF VALVE

- A. General
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Pacific Seismic Products (California Valve, formerly Koso)
 - 2. Description: Automatic shut-off valve for natural gas service, actuated by earthquake event. Positive closure with visual open/close indicator, closure time interval within 5 seconds when subjected to a sinusoidal oscillation with peak acceleration of at least 0.3 G and a period of 0.4 seconds.
 - 3. Body: Cast iron or die-cast aluminum.
 - 4. Listing: UL listed, certified to current ASCE 25-97 Standard. (Listed by UL & Certified by CA State Architect in accordance with ASCE 25-97)
 - 5. Capacity: As shown on drawings.
 - 6. Reset: Manual.
- B. Horizontal Seismic Shut-Off Valves, Low Pressure
 - 1. Maximum Operating Pressure of 5 PSIG. Comply with ASCE/SEI 25.
 - 2. Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 - 3. Cast-aluminum body with nickel-plated chrome steel internal parts.
 - 4. NBR valve washer.
 - 5. Sight windows for visual indication of valve position.
 - 6. Threaded end connections complying with ASME B1.20.1.
 - 7. Wall-mounting bracket with bubble level indicator.

2.07 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. Subject to compliance with requirements, provide products by one of the following: a. A. McDonald Mfg. Co.
 - b. Watts, a Watts Water Technologies company
- 2. Description:
 - a. Standard: ASSE 1079, Performance Requirements for Dielectric Pipe Unions.
 - b. Pressure Rating: 125 psig minimum at 180°F.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping according to NFPA 54 to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54 requirements for prevention of accidental ignition.

3.03 OUTDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 for installation and purging of natural-gas piping.
- B. Install fittings for changes in direction and branch connections.
- C. Install pressure gage downstream from each service regulator.
- D. Install seismic shut-off valve downstream of utility meter and customer shut-off valve, and upstream of any branch piping.

3.04 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless approved by Engineer.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Verify final equipment locations for roughing-in.
- L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

- M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- N. Extend relief vent connections for line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
 - 1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
 - 2. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
 - a. Exception: Tubing passing through partitions or walls does not require striker barriers.
 - 3. Prohibited Locations:
 - a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys, or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
 - b. Do not install natural-gas piping in solid walls or partitions.
- P. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- Q. Connect branch piping from top or side of horizontal piping.
- R. Install unions in pipes NPS 2and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- S. Do not use natural-gas piping as grounding electrode.
- T. Install strainer on inlet of each line-pressure regulator and electrically operated valve.
- U. Install pressure gage downstream from each line regulator.
- V. Install sleeves for piping penetrations of walls, ceilings, and floors.
- W. Install sleeve seals for piping penetrations of concrete walls and slabs.
 - Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.05 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- D. Install seismic shut-off (earthquake) valves aboveground outside buildings according to listing.
 - 1. Seismic shut-off valves shall be attached to the building in the horizontal or vertical piping assembly. Valve shall not be installed free standing on the gas line.
- E. Do not install valves in HVAC (Div. 23) return-air plenums.

3.06 PIPING OINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.

- 4. Apply appropriate tape or thread compound to external pipe threads.
- 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

3.07 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and supports specified in Section 22 05 29 -Hangers and Supports for Plumbing Piping and Equipment.

3.08 APPLIANCE CONNECTIONS

- A. Install piping adjacent to appliances to allow service and maintenance of appliances.
- B. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- C. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.09 PAINTING

- A. Comply with requirements in Division 09 for painting interior and exterior natural-gas piping.
- B. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Test, inspect, and purge natural gas according to NFPA 54 and authorities having jurisdiction.
- C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.11 OUTDOOR PIPING SCHEDULE

- A. Aboveground natural-gas piping NPS 2 and smaller shall be:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.

3.12 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 2 PSIG

- A. Aboveground piping NPS 2 and smaller shall be:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.

FUEL FIRED DOMESTIC WATER HEATERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Condensing Gas Fired Water Heaters, tank type

1.02 ACTION SUBMITTALS

- A. Provide submittals for products listed in the Product Table below in accordance with Section 22 05 00 – General Plumbing Provisions. Submittal requirements indicated by column number designation as follows:
 - 1. Materials List
 - 2. Catalog Data
 - 3. Product Data
 - 4. Performance Data
 - 5. Wiring Diagrams
 - 6. Shop Drawings
 - 7. Installation Instructions
 - 8. Special Requirement listed herein.

PRODUCT TABLE	1	2	3	4	5	6	7	8
Condensing Gas Fired Water Heaters,								
Tank type								

1.03 QUALITY ASSURANCE

- A. Constructed in accordance with ASME Water Heater and Pressure Vessel Code, Section IV (HLW) Potable Water Heaters.
- B. Performance to exceed ASHRAE/IES 90.1b-1992.
- C. UL listed for the application.

1.04 WARRANTY

- A. Condensing Gas-Fired Water Heaters
 - 1. Pressure vessel shall carry 10-year from date of shipment, non-prorated, limited warranty against failure due to waterside corrosion, mechanical defects, or workmanship.
 - 2. Heat exchanger shall carry a 10-year from date of shipment, prorated, limited warranty against failure.

PART 2 - PRODUCTS

2.01 CONDENSING GAS FIRED WATER HEATERS TANK TYPE

- A. Acceptable Manufacturer: A.O. Smith, Bradford White, or approved equal.
- B. General: Fully assembled, natural gas-fired, condensing water heater. Single point electrical connection. Approved for 0-inch clearance to combustibles. Suitable for use with sealed ABS or CPVC exhaust and combustion air intake. Maximum working pressure 160 psi. 94% thermal efficiency.
- C. Components:
 - 1. Tank: Glass-lined steel tank with polyurethane foam insulation and heavy gauge steel outer jacket with baked enamel finish.
 - 2. Controls: Integrated solid-state temperature and ignition control device with integral diagnostics, LED fault display capability, and digital display of temperature settings.
- D. Performance: Size and capacity as scheduled.

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- E. Pressure and temperature relief valve provided hereunder.
- F. Expansion tank size to accommodate expansion in downstream domestic hot water piping provided hereunder, see Section 22 11 19 Domestic Water Piping Specialties.
- G. Condensate Neutralizer: Corrosion resistant tube with inlet and outlet, acid-resistant coupling and clamps, and mounting brackets. Neutralizer shall be delivered with a full charge of limestone chips and enough extra for two refills. Similar to JJM Alkaline Technologies model CBM-225.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install where shown on drawings in accordance with manufacturer's installation instruction including required service clearances and venting guidelines.
- B. Install on concrete base. Base height high enough to allow condensate drainage through an above-grade trap with drain piping continuously sloped to floor drain.
- C. Drain piping at least full size of water heater drain connection.
- D. Connect gas piping to water heater gas-train as detailed. Include unions to aid maintenance.
- E. Install piping from safety relief valves to nearest floor drain.
- F. Controls: All necessary control components needed to provide a complete and fully operational system with the exception of conduit and wiring shall be provided hereunder.

COMMERCIAL PLUMBING FIXTURES

PART 1 GENERAL

1.01 DEFINITIONS

- A. GPF: Gallons per flush.
- B. GPM: Gallons per minute.

1.02 ACTION SUBMITTALS

- A. Provide submittals for products listed in the Product Table below in accordance with Section 22 05 00 – General Plumbing Provisions. Submittal requirements indicated by column number designation as follows:
 - 1. Materials List
 - 2. Catalog Data
 - 3. Product Data
 - 4. Performance Data
 - 5. Wiring Diagrams
 - 6. Shop Drawings
 - 7. Installation Instructions
 - 8. Special Requirement listed herein.

PRODUCT TABLE	1	2	3	4	5	6	7	8	
All Products in this Section									

PART 2 PRODUCTS

2.01 WATER CLOSETS

- A. Acceptable Manufactures:
 - 1. Fixtures: American Standard, Crane, Kohler, Sloan
 - 2. Flush Valves: Sloan, Zurn
 - 3. Seats: Bemis, Benke, Church, Olsonlite
 - 4. Carriers: Charlotte Pipe and Foundry Co, Josam, JR Smith, Mifab, Watts, Zurn
- B. Water Closets (WC-1)
 - 1. Fixtures: American Standard Afwall Millennium. Vitreous china with antimicrobial surface finish. Siphon jet action, elongated bowl, wall hung, top spud, MaP score of 1,000 grams at 1.1 to 1.6 GPF.
 - 2. Flush Valve: Sloan Royal 111 SFSM-1.28. Exposed, top spud, battery-powered sensoractivated diaphragm flush-valve. True mechanical override button. Screwdriver angle stop with protective cap, vacuum breaker, chrome plated. 1.28 GPF.
 - 3. Seat: Bemis Manufacturing No. 1955-C white. Open front. Elongated. Concealed check hinge.
 - 4. Carrier: Adjustable supports for siphon jet closet. Adjustable coupling. No-hub fittings. Arrangement as required for each fixture installation.
- C. Water Closets (WC-2): Same as WC-1 except mounted at ADA height.

2.02 URINALS

- A. Acceptable Manufacturers:
 - 1. Fixtures: American Standard, Crane, Kohler, Sloan
 - 2. Flush Valves: Sloan, Zurn
 - 3. Carriers: Josam, JR Smith, Watts, Zurn
- B. Urinals (U-1)
 - 1. Fixtures: American Standard Washbrook FloWise. Vitreous china with antimicrobial surface finish. Washout action, wall hung, top spud, compatible with 0.125 to 1.0 GPF flushometers.

- 2. Flush Valve: Sloan Royal 186 SFSM-0.125. Exposed, top spud, battery-powered sensoractivated diaphragm flush-valve. True mechanical override button. Screwdriver angle stop with protective cap, vacuum breaker, chrome plated. 0.125 GPF.
- 3. Carrier: Adjustable supports. Arrangement as required for each fixture installation.

2.03 LAVATORIES

- A. Acceptable Manufactures:
 - 1. Lavatories: American Standard, Crane, Kohler, Sloan
 - 2. Faucets: American Standard, Chicago, Sloan, Symmons, T&S Brass
 - 3. Trim: Elkay, Just
 - 4. Supplies and Stops: Chicago, McGuire Mfg. Co.
- B. Lavatories (L-1):
 - 1. Fixture: Sloan SS-3001-STG. Vitreous china oval undermount lavatory fixture with front overflow. 19-1/2-inches x 16-1/2-inches x 7-1/2-inches deep.
 - 2. Trim: Elkay LK-9 grid strainer with 1-1/4-inch tailpiece, chrome plated.
 - 3. Faucet: Sloan SF-2350-BAT-BDT-CP-0.5GPM-MLM-IR-FCT. Chrome-plated 4-inch spacing centerset brass faucet with infrared sensor control, 0.5 GPM laminar spray outlet, battery powered, below deck thermostatic mixing valve. ADA compliant.
 - 4. Supplies and Stops: Angle valve with integral spring check and loose key handle. ½-inch I.P.S. female inlet, 3/8-inch O.D. flexible tubing. Wall flange, polished chrome plated finish.

2.04 SINKS

- A. Acceptable Manufacturers:
 - 1. [']Fixtures: Elkay, Just
 - 2. Faucets: American Standard, Chicago, Elkay, Moen, Sloan, Symmons, T&S Brass and Bronze Works.
 - 3. Trim: Elkay, Just.
 - 4. Supplies and Stops: Chicago, McGuire Mfg. Co.
- B. Sinks (S-1):
 - 1. Fixture: Elkay LRAD-312265, single compartment, 18-gauge, type 304 stainless steel. Drop-in, self-rimming, undercoated. Bowl dimensions 28-inches x 16-inches x 6-3/8-inches deep. Single center hole and right side hole for hot water dispenser.
 - 2. Trim: Elkay stainless-steel drain outlet with 1-1/2-inch chrome-plated brass tailpiece and crumbcatcher.
 - 3. Faucet: Elkay LKGT1041. Chrome-plated brass high arc faucet with single lever handle, pull-out spray head, and high rise base. 1.75 GPM flow rate control. ADA compliant.
 - a. Individual fixture thermostatic mixing valve: Provided hereunder. See Section 22 11 19 - Domestic Water Piping Specialties.
 - 4. Supplies and Stops: Angle valve with integral spring check and loose key handle. ½-inch I.P.S. female inlet, 3/8-inch O.D. flexible tubing. Wall flange, polished chrome plated finish.
- C. Sinks (S-2)
 - 1. Fixture: Elkay ELUHAD-131655, single compartment, 18-gauge, type 304 stainless steel. Undermount, undercoated. Bowl dimensions 13-1/2-inches x 16-inches x 5-3/8-inches deep.
 - 2. Trim: Elkay stainless-steel drain outlet with 1-1/2-inch chrome-plated brass tailpiece and crumbcatcher.
 - 3. Faucet: Chicago W4D-GN2AE35-369AB. Chrome-plated brass gooseneck faucet with 4-inch centers, lever handles, 1.5 GPM flow rate control. ADA compliant.
 - a. Individual fixture thermostatic mixing valve: Provided hereunder. See Section 22 11 19 - Domestic Water Piping Specialties.
 - 4. Supplies and Stops: Angle valve with integral spring check and loose key handle. ½-inch I.P.S. female inlet, 3/8-inch O.D. flexible tubing. Wall flange, polished chrome plated finish.

2.05 SHOWERS SH 1

- A. Acceptable Manufacturers:
 - 1. Shower Fixture: Acorn, Bradley, Chicago, Powers, Symmons.

- 2. Shower Base: American Standard.
- B. Shower Fixture:
 - 1. Symmons 9603PLR-CHKS. Pressure balancing brass shower valve with lever handle, high temperature stop, integral check stops, chrome plated finish. Hand shower shall have a 2.0 GPM flow restrictor, 60-inch flexible metal hose, in-line vacuum breaker, and 36-inch mounting bar for the hand shower with adjustable height mounting.
 - 2. Shower Base: American Standard solid surface ADA shower base with center drain, 3 sided tiling flange.

2.06 MOP SINK MS 1

- A. Acceptable Manufacturers: Acorn Engineering, American Standard, Kohler, Stern-Williams.
- B. Fixture: Stern-Williams Serviceptor SB-900 terrazzo-type mop sink. 24-inches x 24-inches x 12inches deep with stainless steel edge caps. and 10-inch high 20 gauge 304 stainless-steel splash catcher panels on two sides. Hose and wall hook
- C. Faucet: Chicago No. 897-CRCF faucet. Vacuum breaker spout with ³/₄" hose thread outlet, pail hook with wall support, lever handles, chrome-plated finish.
- D. Drain: Integral cast brass 3-inch drain with stainless-steel strainer.
- E. Accessories:
 - 1. Splash Catcher Panel: 10-inch high 20 gauge 304 stainless-steel splash catcher panels on two sides.
 - 2. Hose and Wall Hook: 3-inch long hose with ³/₄-inch hose threading on one end, stainless steel wall bracket with spring-loaded grip.
 - 3. Mop Hanger: Stainless-steel wall-mounted mop hanger, 24-inches long with three rubber spring-loaded grips.

2.07 HOT WATER DISPENSERS

- A. Acceptable Manufacturers: Franke, InSinkErator, Ready Hot.
- B. Fixture: InSinkErator Model H-HOT150, 2/3-gallon tank capacity, 750 Watts, 120 volts.

2.08 GARBAGE DISPOSALS

- A. Acceptable Manufacturers: InSinkErator, Kitchen Aid, Waste King.
- B. Fixture: InSinkErator Evolution Compact. ³/₄ horsepower, 120 volts. Two-stage grinder, sound reducing baffles, permanently lubricated upper and lower bearings, anti-vibration mountings, stainless-steel grinding components.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Accurately plumb, horizontal and in-line. Exposed top or globe valve accessibly located when building is completed; locate behind or below fixture served; otherwise in branch piping as approved. Cast brass or 17-gauge fixture traps with cleanout plugs.
- B. Drains: Examine floor rough-in to receive drain for unevenness, irregularities and incorrect dimensions that would affect quality and execution of installation. Do not install until rough-in is sufficient for proper installation. Coordinate installation of drain with other trades to insure watertight seal.
- C. Thermostatic Mixing valves: Provide for fixtures where indicated. Install in accordance with manufacturer's instructions. Unless otherwise indicated, set temperatures for the following:
 - 1. Lavatories: 110°F.
 - 2. Sinks: 120°F.

3.02 FINISH

A. Exposed metal parts and piping and under counters, polished chromium plated, unless otherwise specified. Baked white enamel escutcheons at ceilings, chrome plated at walls and floors.

3.03 PROTECTION

A. Fixture damaged during construction replaced with new and perfect fixtures without expense to Owner. Protect fixture and trim finish during construction with suitable covering.

3.04 MOUNTING HEIGHT

- A. As shown on Drawings or as recommended by manufacturer.
- B. Wall hung water closets designated for handicapped use; mount between 17" and 19" seat height above floor.
- C. Mop Sink Faucets: Mount 36-inches maximum above finished floor.

DRINKING FOUNTAINS AND WATER COOLERS

PART 1 GENERAL

1.01 ACTION SUBMITTALS

- A. Provide submittals for products listed in the Product Table below in accordance with Section 22 05 00 – General Plumbing Provisions. Submittal requirements indicated by column number designation as follows:
 - 1. Materials List
 - 2. Catalog Data
 - 3. Product Data
 - 4. Performance Data
 - 5. Wiring Diagrams
 - 6. Shop Drawings
 - 7. Installation Instructions
 - 8. Special Requirement listed herein.

PRODUCT TABLE	1	2	3	4	5	6	7	8
Bottle Fillers								

1.02 CLOSEOUT SUBMITTALS

A. Maintenance Data: For drinking fountains to be included in maintenance manuals.

1.03 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filter Cartridges: One for each fixture.

PART 2 PRODUCTS

2.01 BOTTLE FILLERS

- A. Water Coolers (BF-1 : Wall-mounted, wheelchair accessible, refrigerated, filtered bottle filler.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkay Manufacturing Co.
 - b. Halsey Taylor.
 - c. Haws Corporation.
 - d. Oasis.
 - 2. Basis of Design: Elkay Manufacturing Co. LZWSM8K.
 - 3. Standards:
 - a. Comply with NSF 61 Annex G.
 - b. Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers.
 - 4. Cabinet: All stainless steel.
 - 5. Control: Sensor-activated.
 - 6. Drain: Grid with NPS 1-1/4 tailpiece.
 - 7. Supply: NPS 3/8 with shutoff valve.
 - 8. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
 - 9. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
 - 10. Bottle Filler: Sensor-activated with auto shut-off, 1.1 GPM fill rate with laminar flow.
 - 11. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.

- 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.
- 12. Cooled Drinking Water Capacities and Characteristics:
 - a. Cooled Water: 8 gallons per hour.
 - b. Ambient-Air Temperature: 90 deg F.
 - c. Inlet-Water Temperature: 80 deg F.
 - d. Cooled-Water Temperature: 50 deg F.
- 13. Electrical Connection: Plug-in.
- 14. Electrical Capacities: As noted on drawings.
- 15. Mounting Height: Handicapped/elderly according to ICC A117.1.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls and floors for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- B. Install recessed bottle fillers secured to wood blocking in wall construction.
- C. Install mounting frames, affixed to building construction, and attach recessed bottle fillers to mounting frames.
- D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball valves. Install valves in locations where they can be easily reached for operation. Install valve upstream from filter for water cooler.
- E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings.
- G. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color.

3.03 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 and as scheduled.
- B. Install ball shutoff valve on water supply to each fixture.

3.04 AD USTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust water cooler temperature settings.

3.05 CLEANING

- A. After installing fixtures, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.
- C. Provide protective covering for installed fixtures.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

SECTION 23 0500

GENERAL HVAC PROVISIONS

PART 1 GENERAL

1.01 CONTRACT DOCUMENTS

- A. General HVAC provisions apply to all work performed in Division 23.
- B. The Contract Documents are complementary. What is required by anyone, as affects this Division, shall be as binding as if repeated herein.
- C. Separation of this Division from other Contract Documents shall not be construed as segregation of the Work.
- D. Location of equipment on Drawings is approximate. Plan exact location with respect to site measurements and work of other trades prior to starting work. If measurements differ slightly, modify work. If measurements differ substantially, notify Architect/Engineer and Owner's Authorized Representative prior to fabrication.
- E. Make minor changes in equipment connections and equipment locations as directed or required before rough-in without extra cost.
- F. For products specified by listing one or more manufacturers, followed by "Similar to" and one manufacture's model number, the following requirements apply:
 - 1. Approval of each listed manufacturer is contingent upon that manufacturer having a product which meets the specification, fits in the available space, and is comparable to the listed model.
 - 2. Electrical requirements, duct requirements, pipe connections, and space requirements indicated on drawings are based on the listed model and may not be suitable for all manufacturers listed. Provide revisions required to accommodate the model actually furnished.
- G. For product specified by listing one or more manufacturers, followed by a model number for each manufacturer, the following requirements apply:
 - 1. Provide one of the listed model numbers or an approved substitution.
 - 2. Electrical requirements, duct connections, pipe connections, and space requirements indicated on the Drawings are based on one of the listed models and may not be suitable for all models listed. Provide revisions required to accommodate the model actually furnished.

1.02 DEFINITIONS

- A. Authority Having Jurisdiction (AHJ): A federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority.
- B. Owner's Authorized Representative (OAR): Owner's representative with authority to act on Owner's behalf.
- C. Architect/Engineer: The design professional leading the design team and can be either an architect or engineer.
- D. The words furnish, install and provide are defined as follows:
 - 1. Furnish: To supply and deliver to the project ready for installation and in operable condition.
 - 2. Install: To place in final position, complete, anchored, connected in operable condition.
 - 3. Provide: To furnish and install complete. Includes the supply of specified services.
 - 4. When neither furnish, install or provide is stated, provided is implied.

1.03 COORDINATION

A. Check drawings of other trades to avert possible installation conflicts. Should major changes from original drawings be necessary to resolve such conflicts, notify Architect/Engineer and secure written approval and agreement on necessary adjustments before start of work.

- B. Architectural drawings govern all other drawings. Consult in detail the door swings, counter heights and similar items affecting work before rough-in.
- C. Coordinate identification systems with other trades. All mechanical systems shall use identical piping, valve, and equipment identification and regulatory signage.

1.04 SUBMITTALS AND SHOP DRAWINGS

- A. See Division 01 30 00 Administrative Requirements.
- B. Action Submittal Content
 - 1. Action submittal information not expressly required by the specifications will not be reviewed.
 - 2. Action submittal information shall be provided in sufficient detail to establish conformance with specified requirements. Where submitted literature includes multiple models, features, or options, the specific models, features, or options proposed shall be clearly indicated. Where a brief inspection shows that product data is not complete, the submittal will be rejected without review.
 - 3. Action submittal data shall be clear, concise, legible, and relevant. Where data is not properly organized and contains significant information that is not relevant, the submittal will be rejected without review.
 - 4. Action submittal requirements are listed in individual specification sections. The following definitions apply.
 - a. Materials List: Provide tabular list of materials including specification reference, specification product name, manufacturer, model/part number, and size and/or quantity where appropriate. Do not include supplemental data, except where specifically requested.
 - b. Catalog data: Manufacturer's standard product cut sheet.
 - c. Product Data: Detailed data including dimensions, weight, materials of construction, connections, and all other information needed to confirm that the product conforms to all requirements listed in the individual specification section.
 - d. Performance Data: Capacity, input, output, flow, etc. as required to confirm that the product meets the performance requirements scheduled in the Specifications or on the Drawings.
 - e. Wiring Diagrams: Power and control wiring diagrams.
 - f. Shop Drawings: Construction drawings of items manufactured specifically for this project including dimensions, construction details, weights, and additional information to identify the physical features of the system or piece of equipment.
 - g. Installation Instructions
 - h. Special Requirements Listed: Additional requirements indicated in individual specification sections.
- C. Delegated Design
 - 1. Delegated work will include but is not limited to the following:
 - a. Section 23 05 29 Hangers and Supports for HVAC Piping and Equipment.
 - b. Section 23 05 48 Vibration and Seismic Controls for HVAC.
 - 2. 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.
 - a. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.

1.05 QUALITY ASSURANCE

- A. All materials and equipment provided hereunder shall be installed and started in complete conformance with the manufacturer's recommendations.
- B. Asbestos products or equipment or materials containing asbestos shall not be used.

C. Certify that each welder has passed the American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.

1.06 DESIGN REQUIREMENTS

- A. Equipment and systems provided hereunder shall be rated to provide performance specified and scheduled on Drawings at the elevation of the project site.
- B. Materials and equipment provided hereunder shall be rated for the service conditions of the system to which they are connected including but not limited to temperature, pressure, and humidity.
- C. Materials and equipment provided hereunder shall comply with the USDOT FTA Buy America Requirements (49 CFR 661)

1.07 CODES AND STANDARDS

- A. Applicable codes and standards shall determine minimum requirements for materials, methods, and labor practices not otherwise stated herein.
- B. Work shall comply with the Americans with Disabilities Act (ADA).

1.08 SEQUENCING

- A. Testing, adjusting, and balancing of HVAC systems will begin after commissioning construction checks and equipment start-up are complete and Systems Ready to Balance Checklist forms have been executed and submitted.
- B. Submit schedule for operator training eight weeks prior to Substantial Completion. Schedule shall include time and duration of each required training session.
- C. Submit control verification reports three weeks after Substantial Completion.
- D. Submit draft operations and maintenance manuals to Owner's Authorized Representative 30 days prior to substantial completion.
- E. Operator training shall be performed prior to Substantial Completion, or as otherwise approved by the Owner's Authorized Representative.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in a clean and dry place.
- B. Comply with manufacturer's written rigging and installation instructions for unloading and moving to final installed location.
- C. Handle products carefully to prevent damage, breaking, denting, and scoring. Do not install damaged products.
- D. Protect products from weather, dirt, dust, water, construction debris, and physical damage.
- E. Retain factory-applied coverings on equipment to protect finishes during construction and remove just prior to operating unit.
- F. Cover unit openings before installation to prevent dirt and dust from entering inside of units. If required to remover coverings during unit installation, reapply coverings over openings after unit installation and remove just prior to operating unit.
- G. Replace installed products damaged during construction.

1.10 OPERATIONS AND MAINTENANCE MANUALS

- A. Furnish operation and maintenance data for project, as described herein.
- B. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF files.
 - 1. Include a directory of all subcontractors and maintenance contractors with names, addresses, and telephone numbers, indicating the area of responsibility for each.
 - 2. 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.

- 3. Provide a composite summary table indicating each item of equipment listed in the operations and maintenance manual and its required maintenance and time period. This summary table shall be the first section in the O&M manual.
- 4. Manual Content: Manuals shall contain complete information for each item of mechanical, electrical or other operating equipment. Include as applicable:
 - a. Manufacturer's instructions for installation, startup, operation, inspection, and maintenance
 - b. Lubrication schedules
 - c. Performance capacity
 - d. Final approved product submittals for each product included in project.
 - 1) Mark the model actually provided where the literature covers more than one model. Include all submittal data corrected to "as-built" conditions within the manual.
 - 2) Parts list
 - e. Maintenance schedules
 - f. Maintenance instructions shall indicate routine-type work with step-by-step instructions that should be performed to ensure long life and proper operations. Recommended frequency of performance shall also be included.
- 5. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- 6. Provide electronic configuration files for all packaged equipment control systems furnished with equipment.

1.11 RECORD DRAWINGS

A. Provide record "as-built" drawings in accordance with Division 01 requirements. Show all deviations from contract drawings and location of underground lines by accurate dimensions from building lines. Show depth of all stub outs and underground lines. Dimension all concealed piping from column grids or building lines. Alternately, provide electronically using .pdf markup of contract drawings.

PART 2 PRODUCTS

2.01 PRODUCTS AND MATERIALS

- A. All materials employed in permanent construction shall be new, full weight, in first class condition, and suitable for space provided. All similar equipment and materials shall be of one manufacturer.
- B. Equipment used as the basis of design is scheduled on Drawings or designated in product specifications. If Contractor chooses to use equipment that is not the basis of design, Contractor is responsible for all re-design and construction costs associated with variations in arrangement, dimension, or capacity. Such work may include, but is not limited to, changes to facility structure or dimensions and revisions to associated mechanical and electrical systems needed to provide equal system performance and maintainability.

2.02 ELECTRICAL EQUIPMENT

- A. Electrical Disconnect Switch: Electrical disconnect switches specified for mechanical equipment shall conform to OSHA Lock-out/Tag-out requirements.
- B. All electrical equipment shall be listed as approved for its application by the Underwriters Laboratory or other testing agency approved by the State of Oregon Electrical and Elevator Board. Approval indicates agency meets testing standard requirements for electrical safety required by Oregon Revised Statutes 479.510 through 479.855 and Oregon Administrative Rules.
- C. Enclosure: Provide the following electrical equipment enclosure types.

- 1. NEMA 1: Dry, enclosed locations where the ambient temperature will not be outside of the VFD temperature ratings.
- 2. NEMA 12: Enclosed mechanical spaces equipped with floor drains where dripping or splashing may occur and where the ambient temperature will not be outside of the VFD temperature ratings.
- 3. NEMA 3R, 4, or 4 with Temperature Control: Outdoors or in unconditioned spaces where ambient temperatures will be outside of the VFD temperature ratings.

2.03 BELT DRIVES FOR HVAC EQUIPMENT

- A. Provide belts, pulleys, and belt guards for a belt driven equipment.
- B. Belt Drives: Factory mounted, with adjustable alignment and belt tensioning
 - 1. Standard Equipment: One or more belts with 1.35 service factor based on fan motor.
 - 2. Critical Equipment: Two or more belts with 2.5 service factor based on fan motor shall be provided for equipment that is served by a standby power system or provides an emergency or life-safety function.
- C. Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
- D. Motor Pulleys: Adjustable pitch for use with 7.5-hp motors and smaller; fixed pitch for use with motors larger than 7.5 hp. Select pulley size so pitch adjustment is at the middle of adjustment range at fan design conditions.
- E. Belts: Oil resistant, non-sparking, and non-static; in matched sets for multiple-belt drives.
- F. Belt Guards: Comply with requirements specified by OSHA and fabricate according to SMACNA's "HVAC Duct Construction Standards"; 3/4-inch diamond-mesh wire screen, welded to steel angle frame; prime coated.

2.04 ROOF CURBS, BASES, AND RAILS WITHOUT INTEGRAL VIBRATION ISOLATION

- A. Acceptable Manufacturer: Greenheck, The Pate Company, Thybar.
- B. Related Sections: See Section 23 05 48 Vibration and Seismic Control for curbs or bases that include integral vibration isolation.
- Roof equipment curbs, bases and rails shall be provided by supplier of associated equipment and conform to the following requirements and to requirements shown on Drawings:
 General:
 - a. Submittals: Provide curb, base, and rail submittals as part of associated rooftop equipment submittal packages.
 - b. Seismic and Wind Load: Design curbs, bases, and rails to withstand seismic and wind load forces on equipment in accordance with performance requirements listed in Division 23. Provide attachments including
 - 1) Equipment to curb, base, or rail.
 - 2) Curb, base, or rail to building structure.
 - c. Provide design calculations verifying that seismic and wind load restraint will comply with the Oregon Structural Specialty Code for the site and the building type listed. Drawings, details, and calculations related to seismic and wind load design shall be signed and sealed by an engineer specializing in the associated work and registered in Oregon.
 - 2. Coordination: Coordinate configuration and height of curb with roofing contractor.
 - a. Provide sloped curbs to match roof conditions.
 - b. Curbs shall be provided with cants compatible with roofing system and roofing insulation thickness in accordance with roofing manufacturer's recommendations.
 - c. Provide wood nailers where required.
 - d. Provide 16-inch curbs, except as otherwise specified or shown on Drawings. Adjust curb height for roof insulation thickness. Exposed curb height above insulation shall be not less than twelve inches.

- 3. Curbs
 - a. Base: Constructed of G90 galvanized steel framing. Design internal framing to accommodate ductwork, air plenums, piping and conduit as shown on Drawings. Components shall be non-combustible.
 - b. Damper Tray: Provided by curb manufacturer where required.
 - c. Insulation: Factory or field applied closed-cell insulation with a minimum R-value of R-4.
 - d. Furnish curb with integral crickets if required by roof installation.
- 4. Equipment Bases:
 - a. Base: 16-inch tall constructed of G90 galvanized-steel framing. Design internal framing to accommodate piping and conduit shown routed through curb housing. Components shall be non-combustible.
 - b. Platform: Structural deck and minimum 22-gauge 304 stainless-steel cap flashing with welded corner seams. Deck shall support a minimum uniform top loading of 100 pounds per square foot, excluding equipment point loads.
 - c. Support Channels: Provide structural channel or hat channel welded to top of cap flashing for equipment support and anchorage. Support channel shall be designed to support equipment point loading and located for attachment to equipment base connections. Channel shall be sized to provide required horizontal bearing surface as required by equipment manufacturer and to accommodate vibration isolation.
 - d. Insulation: Factory or field applied closed-cell insulation with a minimum R-value of R-4.
 - e. Piping Housing: Provide piping housing at one end of curb for routing piping and conduit up through curb to equipment when shown on Drawings. Housing shall have sealable side openings to provide waterproof penetrations. Housing material and construction shall match cap flashing and have removable top access cover.
- 5. Rails
 - a. Base: Constructed of G90 galvanized-steel framing. Components shall be non-combustible.
 - b. Cap Flashing: Minimum 22-gauge, 304 stainless-steel, cap flashing with welded corner seams.

2.05 SPECIAL TOOLS AND LUBRICANTS

- A. Furnish and turn over to Owner's Authorized Representative, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.
- B. Grease Guns with Attachments for Applicable Fittings: Provide one for each type of grease required for motor or other equipment.
- C. Lubricants: Provide a minimum of one quart of oil, and one pound of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

PART 3 EXECUTION

3.01 ACCESS TO EQUIPMENT AND ACCESSORIES

- A. Install equipment with sufficient access for service. Where not conveniently accessible by other means, provide adequately sized access doors for valves, dampers, motors, belts, and all other mechanical equipment requiring access for removal or maintenance. Type, size and exact location of access doors shall be coordinated with Architect/Engineer prior to work.
- B. Provide clearances for maintenance access as indicated on Drawings or as recommended by manufacturer. If access requirements shown on Drawings conflict with manufacturer's recommendations, provide larger clearance of the two.
- C. If equipment location shown on Drawings does not allow required access, notify Architect/Engineer prior to start of work.

- D. Apply and install all items in accordance with manufacturer's written instructions. Refer conflicts between the manufacturer's instructions and the contract drawings and specifications to Architect/Engineer for resolution prior to starting work.
- E. Provide access doors as required for access to mechanical equipment. Doors required for access are not necessarily shown on Drawings. Consult with Architect/Engineer for direction on placement of required doors not shown on Drawings.
 - 1. Comply with manufacturer's instructions for installation of access doors. Provide all necessary support and supplemental framing for assembly where the access doors are required. Set accurately in position, plumb, level, and flush to adjacent finish surfaces; and secure to support.
- F. Where ladder access is required to service elevated components, provide an installation that provides for sufficient access within ladder manufacturer's written instructions for use.
- G. Comply with OSHA regulations.

3.02 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

- A. Coordinate location of piping, sleeves, inserts, hangers, ductwork and equipment. Locate piping, sleeves, inserts, hangers, ductwork and equipment clear of windows, doors, openings, lights, electrical outlets, and other services and utilities. Follow manufacturer's published recommendations for installation methods not otherwise specified.
- B. Equipment and Piping Support: Coordinate structural systems necessary for pipe and equipment support with pipe and equipment locations to permit proper installation.
- C. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.
- D. Minor Piping: Small diameter pipe runs from drips and drains, water cooling, and similar minor services are generally not shown but must be provided. Contractor is responsible to provide all such minor piping where needed to maintain mechanical spaces clean and dry and to allow full equipment function and maintenance.
- E. Interconnection of Controls and Instruments: Generally not shown but must be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments, and computer workstations. Comply with NFPA-70.
- F. Switchgear Drip Protection: Do not install piping above electrical switchgear.
- G. Inaccessible Equipment
 - 1. Where the Owner's Authorized Representative determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost to the Owner.
 - 2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

3.03 ROOF CURBS, BASES, AND RAILS WITHOUT INTEGRAL VIBRATION ISOLATION

A. Curb, Base, Rail Support, Field Built-Up: Install roof curbs, bases, rails on roof structure, level and secure, according to Division 7. Install and secure equipment, and coordinate roof penetrations and flashing with roof construction.

3.04 LUBRICATION

- A. Lubricate all devices requiring lubrication prior to initial operation. Field check all devices for proper lubrication.
- B. Equip all devices with required lubrication fittings or devices.
- C. All lubrication points shall be accessible without disassembling equipment, except to remove access panels.
3.05 CLEANING SYSTEMS

- A. General: After all equipment, pipes and duct systems are installed, system shall be thoroughly cleaned. Remove all stickers and tags from equipment or fixtures. Clean all piping systems prior to installation of insulation or painting.
- B. Hydronic Piping: Clean and flush hydronic piping and strainers as required to complete work described in Section 23 25 13 Water Treatment for Hydronic Systems.
- C. Air Distribution Duct System:
 - 1. Remove all debris from system before operation. Under no circumstances shall system be operated without filters. Replace filters used during construction with new filters.
 - 2. Repair or replace any discolorations or damage to system, building finish, or furnishings resulting from Contractor's failure to properly clean system.

3.06 START UP

- A. The Mechanical Contractor shall be responsible for proper operation of all systems and shall coordinate startup procedures, calibration and system checkout. System operational problems shall be diagnosed and corrected as required for system operation prior to Substantial Completion inspection.
- B. Start equipment in accordance with manufacturer's recommendations and under manufacturer's supervision where required. Ensure that associated filters, strainers, electrical overloads, and other devices intended to protect the equipment are installed and functional prior to startup.
- C. Verify that piping has been flushed and cleaned prior to startup.
- D. The Mechanical Contractor shall perform TAB system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. TAB system-readiness checklists will be provided by the TAB Specialist. See Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.

3.07 DEMONSTRATION

- A. General: After installation is complete, demonstrate to Engineer and Owner's Authorized Representative satisfaction as being complete and operational and entirely in conformance with Contract Documents.
- B. Preparation: Prior to demonstration, submit check-off list indicating completeness of submittals and certificates of compliance for review to Owner's Authorized Representative. Operate completed system for one week. Verify that control verification is complete and verification report has been approved by Architect/Engineer.
- C. Arrange for demonstration with Owner's Authorized Representative, Engineer, required factory technicians, and installer at least one week in advance of demonstration.

3.08 TRAINING

- A. Instruct Owner in proper operation and maintenance of equipment and systems. Instruction shall generally include topics listed in manufacturer's operations and maintenance manual. Operator instructions shall cover all aspects of manual, automatic, and safety controls. Contractor shall also instruct the Owner in the general configuration of systems and location of equipment and components.
- B. Furnish competent qualified technicians knowledgeable in the building HVAC systems and equipment provided for this project for a minimum of 8 hours on-site to instruct Owner in operation and maintenance of systems and equipment. This figure does not include additional training noted under individual specification sections. Contractor shall keep a log of this instruction including date, times, subjects, and those present and shall present such log when requested by Engineer. Contractor shall coordinate training with Owner's Project Manager and provide a schedule for training minimum two-weeks prior to Substantial Completion. All training shall be complete 30-days after Substantial Completion.

- C. Contractor shall furnish training by equipment manufacturers in addition to training described in this section where specifically listed in other sections. Contractor shall schedule training with Owner's Project Manager minimum 48-hours prior to training session. Equipment shall be fully operational prior to scheduling training session. Manufacturer's field start-up, adjustment, and service will not fulfill manufacturer's training requirement.
- D. Contractor shall coordinate operator training with the Owner's Authorized Representative as follows:
 - 1. Training Schedule: Contractor shall develop and submit a training schedule listing all required training including contractor training, manufacturer training, and factory training as specified for approval by the Owner's Authorized Representative.
 - 2. Training Record and Évaluation Section: Contractor shall maintain a Training Record documenting attendees and duration of each training session. The Contractor shall complete Training Record after each training session. Submit training record when all training is complete.

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, squirrel-cage induction and electrically commutated 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.

1.02 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

2.02 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40°C and at altitude of 3,300 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.

2.03 POLYPHASE INDUCTION MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15 unless listed otherwise under section where motor is provided.
- D. Rotor: Random-wound, squirrel cage.
- E. Bearings: Re-greaseable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- F. Temperature Rise: Match insulation rating.
- G. Insulation: Class F.
- H. 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.
- I. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.
- J. Enclosure Type: Provide open drip proof enclosure, except provide totally enclosed fan cooled enclosure for the applications listed below, or as expressly specified elsewhere, or as indicated on Drawings.
 - 1. Outdoor applications including roof exhaust fans, cooling towers, and similar equipment.
 - 2. Fan motors mounted in an unfiltered air stream.
 - 3. Motors on equipment related to life safety including smoke exhaust fans, fire pumps and similar equipment.
 - 4. Motors 10 HP and larger.

- K. Additional Requirements for Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Inverter Duty as defined in NEMA MG 1 with Class F temperature rise; Class H insulation.
 - 2. 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.
 - 3. Maximum RPM: 3600 rpm minimum, or 150% of as design motor speed, whichever is greater.
 - 4. Špeed Ratio:
 - a. Constant load applications: 4:1, except 1000:1 where high turndown motor is required.
 - b. Variable torque applications: 20:1, except 1000:1 where high turndown motor is required.
 - 5. Bearing Protection Ring: For motors controlled by variable frequency drives, provide maintenance free, conductive microfiber, shaft grounding ring with a minimum of two rows of circumferential microfibers to discharge electrical shaft currents within the motor and/or its bearings. AEGIS SGR or approved equal.
- L. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.04 SINGLE PHASE ELECTRICALLY COMMUTATED MOTORS

- A. General: Electrically commentated, variable-speed, DC, brushless, direct drive type. Motor rotor shall be permanent magnet type with near zero rotor losses.
- B. Bearings: Heavy duty, pre-lubricated, antifriction ball bearings.
- C. Motor Controller: Single-phase integrated controller/inverter that operates the wound stator and senses rotor position to electronically commutate the stator. Motors designed for synchronous rotation and to overcome reverse rotation.
 - 1. Operating Speed: Controllable from 100% to 20% of full speed.
 - 2. Motor Control: Remote digital input
 - 3. Speed Control: Provide either manual or remote speed control input as specified and as required to perform intended function:
 - a. Manual: Potentiometer dial mounted on the motor.
 - b. Remote modulating analog input: 4-20mA or 0-10 VDC.
 - 4. Soft-start function to reduce inrush current at start-up
 - 5. Overcurrent Protection
 - 6. Thermal Overload Protection
- D. Electrical Input: Single phase, 60 hertz. Voltage as required or as scheduled on drawings.
- E. Efficiency: Motor shall be minimum of 70% efficient over entire operating range.

2.05 SINGLE PHASE INDUCTION 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: Pre-lubricated, 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

3.01 EXAMINATION

A. Verify motor mounts are compatible with motor frame.

3.02 INSTALLATION

A. Motors Used with Variable Frequency Controllers: Arrange location of motor, variable frequency controller and electrical wiring to ensure the distance from motor to inverter does not exceed manufacturer recommended maximum length.

3.03 APPLICATION

- A. EC Motor Speed Control
 - 1. Remote speed control where required for variable volume applications to perform specified control sequences.
 - 2. Manual speed control for constant volume applications.

B. Induction Motors

- 1. Motors Less Than 1/2 HP: Single-Phase
- 2. Motors 1/2 HP and larger: Polyphase.

COMMON MOTOR CONTROL REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Single Phase Motor Controllers.
 - 2. Enclosed full-voltage magnetic motor controllers.
 - 3. Enclosures.
 - 4. Accessories.

1.02 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. DDC: Direct digital control.
- E. EMI: Electromagnetic interference.
- F. OCPD: Overcurrent protective device.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of magnetic motor controller.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For each type of magnetic controller.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Indicate dimensions, weights, required clearances, and location and size of each field connection.
 - 3. Wire Termination Diagrams and Schedules: Include diagrams for power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer-installed and field-installed wiring.
 - 4. Include features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- C. Product Schedule: List the following for each enclosed controller:
 - 1. NRTL listing.
 - 2. Factory-installed accessories.
 - 3. SCCR of integrated unit.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For magnetic controllers to include in operation and maintenance manuals.
 - 1. In addition to items specified in Division 01, include the following:
 - a. Routine maintenance requirements for magnetic controllers and installed components.
 - b. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
 - c. Manufacturer's written instructions for setting field-adjustable overload relays.
 - d. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.05 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subject to weather, cover controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers.

1.07 FIELD CONDITIONS

- A. Ambient Environment Ratings: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than 23 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet for electromagnetic and manual devices.
 - 3. The effect of solar radiation is not significant.

PART 2 PRODUCTS

2.01 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 use.
- B. Magnetic motor controllers to comply with UL 508 and UL 60947-4-1.
- C. NEMA Compliance: Fabricate motor controllers to comply with ICS 2.
- D. Factory Assembled Equipment:
 - 1. Each motor controller shall be provided with a factory installed isolation switch.

2.02 SINGLE PHASE MOTOR CONTROLLERS

A. Single Phase Motor Control Relay: Refer to 23 09 25 - BAS Field Mounted Devices for HVAC.

2.03 ENCLOSED FULL VOLTAGE MAGNETIC MOTOR CONTROLLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. General Electric Company.
 - 3. Rockwell Automation, Inc.
 - 4. Siemens Industry, Inc., Energy Management Division.
 - 5. Square D; by Schneider Electric.
- B. Description: Across-the-line start, electrically held, for nominal system voltage of 600-V ac and less.
- C. Standard: Comply with NEMA ICS 2, general purpose, Class A.
- D. Configuration: Non-reversing.
- E. Contactor Coils: Pressure-encapsulated type.
 - 1. Operating Voltage: Manufacturer's standard, unless indicated.
- F. Control Power:
 - 1. For on-board control power, obtain from line circuit or from integral CPT. The CPT shall have capacity to operate integral devices and remotely located pilot, indicating, and control devices.

- G. Overload Relays:
 - 1. Solid-State Overload Relay:
 - a. Switch or dial selectable for motor-running overload protection.
 - b. Sensors in each phase.

2.04 ENCLOSURES

- A. Comply with NEMA 250, type designations, complying with environmental conditions at installed location.
- B. The construction of the enclosures shall comply with NEMA ICS 6.
- C. Controllers in hazardous (classified) locations shall comply with UL 1203.
- D. Outdoor Enclosures: Provide heaters, cooling fan, and/or sun shield with temperature control system as required to maintain interior enclose temperature with manufacturer rated operating conditions for all internal components.

2.05 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
- B. Motor protection relays shall be with solid-state sensing circuit and isolated output contacts for hardwired connections.
 - 1. Phase-failure.
 - 2. Phase-reversal, with bicolor LED to indicate normal and fault conditions. Automatic reset when phase reversal is corrected.
 - 3. Under/overvoltage, operate when the circuit voltage reaches a preset value, and drop out when the operating voltage drops to a level below the preset value. Include adjustable time-delay setting.
- C. Space heaters, with NC auxiliary contacts, to mitigate condensation in Type 3R, Type 4, Type 12 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- D. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and space conditions for compliance with requirements for motor controllers, their relationship with the motors, and other conditions affecting performance of the Work.

3.02 INSTALLATION

- A. Comply with NECA 1.
- B. Wall-Mounted Controllers: Install magnetic controllers on walls with tops at uniform height indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks.
- C. Floor-Mounted Controllers: Install controllers on cast-in-place concrete equipment base(s).
- D. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.
- E. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- F. Setting of Overload Relays: Select and set overloads on the basis of full-load current rating as shown on motor nameplate. Adjust setting value for special motors as required by NFPA 70 for motors that are high-torque, high-efficiency, and so on.
- G. Hand-Off-Auto Switch: Safety interlocks for life-safety or emergency shutdown to protect equipment or systems shall be wired so that safety interlocks are active in both Hand and Auto position.

3.03 APPLICATION

- A. Provide motor controllers as scheduled on drawings and as otherwise specified.
- B. Provide Single Phase Motor Control Relays for single phase motors less than 1/2 horsepower.

3.04 FIELD QUALITY CONTROL

- A. Start-up and Testing of Motor Controllers other than VFDs
 - 1. Contractor to test and inspect components, assemblies, and equipment installations, including connections.
 - 2. Tests and Inspections:
 - a. Comply with the provisions of NFPA 70B, "Testing and Test Methods" Chapter.
 - b. Visual and Mechanical Inspection:
 - 1) Compare equipment nameplate data with drawings and specifications.
 - 2) Inspect physical and mechanical condition.
 - 3) Inspect anchorage, alignment, and grounding.
 - 4) Verify the unit is clean.
 - 5) Inspect contactors:
 - a) Verify mechanical operation.
 - b) Verify contact gap, wipe, alignment, and pressure are according to manufacturer's published data.
 - 6) Verify overload element rating is correct for its application.
 - 7) Inspect bolted electrical connections for high resistance.
 - 8) Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
 - c. Electrical Tests:
 - 1) 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. Insulationresistance values shall be according to manufacturer's published data or NETA ATS Table 100.1.
 - 2) Test motor protection devices according to manufacturer's published data.
 - 3) Test circuit breakers as follows:
 - a) Operate the circuit breaker to ensure smooth operation.
 - b) For adjustable circuit breakers, adjust protective device settings according to the coordination study. Comply with coordination study recommendations.
 - 4) Perform operational tests by initiating control devices.
- B. Motor controller will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.05 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain switchgear.

SLEEVES, SLEEVE SEALS, AND ESCUTCHEONS FOR HVAC PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes sleeves, sleeve seals, escutcheons, and related materials.

1.02 ACTION SUBMITTALS

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

PART 2 PRODUCTS

2.01 STACK SLEEVE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Jay R. Smith Mfg. Co.
 - 2. Zurn Industries
- 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.

2.02 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Non-shrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.03 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated or 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.

2.04 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

3.01 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- C. 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.

3.02 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.
 - 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
 - 4. Using grout, seal the space around outside of stack-sleeve fittings.

3.03 SLEEVE AND SLEEVE SEAL SCHEDULE

- 1. Concrete Slabs above Grade and Interior Partitions:
 - a. Galvanized-steel-pipe sleeves.

3.04 ESCUTCHEONS

- 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 piping and with OD that completely covers opening.
- C. Use one-piece, deep-pattern escutcheons for new piping where fittings would protrude from the wall and be exposed if standard escutcheons were used
- D. Escutcheons for New Piping:
 - 1. Finished Areas: One-piece, cast-brass type with polished, chrome-plated finish.
 - 2. Unfinished Areas: One-piece, cast-brass type, rough brass finish.
- E. Install floor plates for piping penetrations of equipment-room floors.
- F. 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.

METERS AND GAGES FOR HVAC PIPING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Thermometers, mounting brackets, and thermowells
 - 2. Pressure gages and gage attachments
 - 3. Test plugs
 - 4. Hydronic sight flow indicators

1.02 ACTION SUBMITTALS

- A. Provide submittals for products listed in the Product Table below in accordance with Section 23 05 00 – General HVAC Provisions. Submittal requirements indicated by column number designation as follows:
 - 1. Materials List
 - 2. Catalog Data
 - 3. Product Data
 - 4. Performance Data
 - 5. Wiring Diagrams
 - 6. Shop Drawings
 - 7. Installation Instructions
 - 8. Special Requirement listed herein.

PRODUCT TABLE	1	2	3	4	5	6	7	8
Thermometers, Thermowells, and Ac- cessories								
Pressure Gauges and Gauge Attach- ments								
Hydronic Sight Flow Indicator								
Test Plugs								

1.03 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 PRODUCTS

2.01 THERMOMETERS, THERMOWELLS, AND ACCESSORIES

- A. Bimetallic-Actuated Thermometers
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ashcroft Inc.
 - b. Marsh Bellofram
 - c. Palmer Wahl Instrumentation Group
 - d. Trerice, H. O. Co.
 - e. Weiss Instruments, Inc.
 - 2. Standard: ASME B40.200.
 - 3. Case: Liquid-filled and sealed type(s); stainless steel with 5-inch nominal diameter.
 - 4. Dial: Non-reflective aluminum with permanently etched scale markings and scales in degrees F.
 - 5. Connector Type(s): Union joint, adjustable angle, rigid back, or rigid bottom selected for ease of reading. Unified-inch screw threads.
 - 6. Connector Size: 1/2 inch, with ASME B1.1 screw threads.
 - 7. Stem: 0.25 or 0.375 inch in diameter; stainless steel.
 - 8. Window: Double strength glass or plastic.

- 9. Ring: Stainless steel.
- 10. Element: Bimetal coil.
- 11. Pointer: Dark-colored metal.
- 12. Scale: Scale: Select the proper scale range so that the operating temperature of the material being measured will be approximately in the middle of the scale. 100°F range, or as required to span entire normal operating range whichever is greater.
- 13. Accuracy: Plus or minus 1 percent of scale range.
- B. Thermowells
 - 1. Standard: ASME B40.200.
 - 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
 - 3. Material for Use with Copper Tubing and PVC Piping: CNR or CUNI.
 - 4. Material for Use with Steel Piping: CRES.
 - 5. Type: Stepped shank unless straight or tapered shank is indicated.
 - 6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
 - 7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
 - 8. Bore: Diameter required to match thermometer bulb or stem.
 - 9. Insertion Length: Length required to match thermometer bulb or stem.
 - 10. Lagging Extension: Include on thermowells for insulated piping and tubing.
 - 11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
 - 12. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.02 PRESSURE GAGES AND GAGE ATTACHMENTS

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ashcroft Inc.
 - b. Marsh Bellofram
 - c. Palmer Wahl Instrumentation Group
 - d. Trerice, H. O. Co.
 - e. Weiss Instruments, Inc.
 - 2. Standard: ASME B40.100.
 - 3. Case: Liquid-filled type; cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
 - 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 - 5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is required.
 - 6. Movement: Mechanical, with link to pressure element and connection to pointer.
 - 7. Dial: Non-reflective aluminum with permanently etched scale markings graduated in psi.
 - 8. Pointer: Dark-colored metal.
 - 9. Window: Double strength glass or plastic.
 - 10. Ring: Metal, Friction fit.
 - 11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.
 - 12. Scale: Black printing on white. 270-degree arc, 0 to 60 range, 1 psi increments. 0 to 100 psi range, 1 psi increments, or as required for system pressure encountered. Range selected so that operating pressure approximately half of full range or maximum scale value exceeds maximum pressure, whichever scale range is greater.
- B. Gage Attachments
 - 1. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and porousmetal-type surge-dampening device. Include extension for use on insulated piping.
 - 2. Siphons: Loop-shaped section of brass pipe with NPS 1/4 pipe threads.
 - 3. Valves: Brass ball, with NPS 1/4, ASME B1.20.1 pipe threads.

2.03 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Sisco Manufacturing Company, Inc.

- 2. Trerice, H. O. Co.
- 3. Watts, a Watts Water Technologies company
- 4. Weiss Instruments, Inc.
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/4, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200°F.
- F. Core Inserts: Chlorosulfonated polyethylene synthetic acceptable for air, gas, oil, and water. EPDM self-sealing rubber acceptable for air and water only.

2.04 HYDRONIC SIGHT FLOW INDICATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Dwyer Instruments, Inc.
 - 2. John C. Ernst Co., Inc.
- B. Basis of Design: John C. Ernst Co., Inc. Model 138P
- C. Description: Piping inline-installation device for visual verification of flow.
- D. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.
 - 1. Minimum Pressure Rating: 125 psig
 - 2. Minimum Temperature Rating: 200°F
 - 3. End Connections for NPS 2 and Smaller: Threaded

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install all equipment in accordance with manufacturer's recommendations.
- B. Thermometers
 - 1. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- C. Thermowells
 - 1. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.
 - 2. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
 - 3. Install thermowells with extension on insulated piping.
 - 4. Fill thermowells with heat-transfer medium.
- D. Pressure Gauges
 - 1. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
 - 2. Install valve and snubber in piping for each pressure gage for fluids.
- E. Test Plugs
 - 1. Install test plugs in piping tees.
 - 2. Location:
 - a. Provide test plug immediately adjacent to each control system component that senses temperature or pressure. For differential pressure transmitters, provide test plug adjacent to both high pressure and low-pressure sensing ports.
 - 3. Arrangement:
 - a. Install so temperature probe and pressure gauge probe can easily be inserted and removed with no obstruction.
- F. Hydronic Sight Flow Indicators
 - 1. Install flow indicators in piping systems in accessible positions for easy viewing.

3.02 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.03 AD USTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gages to proper angle for best visibility.

VALVES FOR HVAC PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Valves for HVAC service.

1.02 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NRS: Non-rising stem.
- D. RS: Rising stem.
- E. SWP: Steam working pressure.

1.03 ACTION SUBMITTALS

A. Catalog Data: For each type of valve.

1.04 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 and globe valves closed to prevent rattling.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher-than-ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded-end valves.
 - 2. ASME B16.1 for flanges on iron valves.
 - 3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 4. ASME B31.1 for power piping valves.
 - 5. ASME B31.9 for building services piping valves.
- C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- E. Valve Pressure and Temperature Ratings: Not less than indicated and as required for maximum system pressures and temperatures. If valves with specified SWP classes or CWP ratings are unavailable, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valves in Insulated Piping:
 - 1. Include 2-inch stem extensions.
 - 2. Ball Valves:

- a. Extended operating handle of nonthermal-conductive material, and protective sleeves that allow operation of valves without breaking the vapor seals or disturbing insulation.
- b. Memory stops shall be fully adjustable after insulation is applied.

2.02 BALL VALVES

- A. NPS 2 and Smaller:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves.
 - b. Hammond Valve.
 - c. Jenkins Valves; Crane Energy Flow Solutions.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Stockham; Crane Energy Flow Solutions.
 - g. Watts; a Watts Water Technologies company.
 - 2. Bronze Ball Valves with Bronze or Brass Trim:
 - 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.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

2.03 BUTTERFLY VALVES

- A. NPS 2-1/2 and Larger, Lug Type:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves.
 - b. Hammond Valve.
 - c. Jenkins Valves; Crane Energy Flow Solutions.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Stockham; Crane Energy Flow Solutions.
 - 2. 200 CWP Lug Type Butterfly Valve:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast-iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless-steel.
 - g. Disc: Bronze, or stainless-steel.
- B. Valve Actuator Types:
 - 1. Handlever: For valves NPS 6 and smaller.
 - 2. Actuator Extension: Suitable for insulation thickness required, but not less than 2-inches.
 - 3. Adjustable Travel Stops: Open and closed position mechanical travel stops that limit valve movement to specific degrees of rotation, field adjustable, stop screws, externally adjustable for gear actuators.

2.04 CHECK VALVES

- A. NPS 2 and Smaller:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves.
 - b. Crane; Crane Energy Flow Solutions.
 - c. Hammond Valve.
 - d. Jenkins Valves; Crane Energy Flow Solutions.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Stockham; Crane Energy Flow Solutions.
 - 2. Class 125, Bronze Swing Check Valve
 - 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. Renewable seats and disc.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 VALVE INSTALLATION

- A. Install valves with unions or flanges to isolate 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 check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Install check valves a minimum of five pipe diameters away from changes of direction, pumps, or equipment that can generate turbulent flow in piping.

3.03 AD USTING

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

3.04 GENERAL VALVE APPLICATIONS

- A. Drain Valves:
 - 1. Where drain valves are required, include hose end connection and cap with EDPM gasket.
 - 2. Provide drain down valves at the low point in each zone, area of service, or floor level.
 - 3. Provide drain down valves to drain equipment.

- B. Gauge Stop Valves:
 - 1. Size to match gauge connection.
- C. Strainer Blowdown Valves:
 - 1. Match blowdown connection.
 - 2. Provide hose end connection and cap with EDPM gasket for valves 1-inch and below.
- D. Provide valves for isolation of services as shown on Drawings and at the following locations:
 - 1. Where piping penetrates the building envelope.
 - 2. At branch connections from piping risers at each floor.
 - 3. Major branches and branches to remote equipment or fixtures for all supply and return systems.
 - 4. As required to individually isolate all equipment and maintainable devices including automatic air vents and hydronic control valves.
 - 5. Where piping penetrates mechanical room walls. Locate valve inside mechanical room.
 - 6. Branch connections for utility systems including piping in utility tunnels.
- E. Provide valves where recommended by equipment manufacturer's installation instructions.

3.05 VALVE SCHEDULE

- A. If valve type shown on drawings is different than type indicated below, notify Engineer prior to ordering to verify type.
- B. General Heating Water, Chilled Water,, Non-potable Water Service
 - 1. General Shutoff Service
 - a. NPS 2 and smaller: Ball Valves with Bronze or Brass Trim
 - b. NPS 2-1/2 and Larger where equipment isolation valves intended for balancing water flow rates: High Performance 285 CWP Lug Type Butterfly valve.
 - 1) Provide in the following locations:
 - a) Chiller evaporator supply isolation valve.
 - 2. Check Valve Service:
 - a. NPS 2 and Smaller: Class 125, Bronze Swing Check Valve.
 - 3. Drain, Gauge Stop, Strainer Blowdown: NPS 2 and smaller: Ball Valves with Bronze or Brass Trim

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Design and installation of hangers and supports for HVAC piping and equipment provided in Division 23. Exceptions include equipment whose structural attachment has been designed by the design team structural engineer.

1.02 DEFINITIONS

A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

1.03 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Supports for multiple pipes, including pipe stands, shall be capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Equipment supports shall be capable of supporting combined operating weight of supported equipment and connected systems and components.

1.04 ACTION SUBMITTALS

- A. Provide submittals for products listed in the Product Table below in accordance with Section 23 05 00 – General HVAC Provisions Submittal requirements indicated by column number designation as follows:
 - 1. Materials List
 - 2. Catalog Data
 - 3. Detailed Data
 - 4. Performance Data
 - 5. Wiring Diagrams
 - 6. Shop Drawings
 - 7. Installation Instructions
 - 8. Special Requirement listed herein.

PRODUCT TABLE	1	2	3	4	5	6	7	8
Pipe Hangers and Supports								
Thermal Hanger Shield Inserts								
Roof Mounted Pipe Stands								
Fabricated framing & support assemblies								

- B. Shop Drawings:
 - 1. Plans showing type and location of supports and assemblies. Provide full or half size copies of piping plans from the Contract Documents or coordination drawings, showing location and type of each support component to be installed. Drawings shall consist of mechanically reproduced copies of the Contract Documents, or new drawings custom drafted specifically for the Work of this Project. Each drawing shall be printed on a single sheet.
 - 2. Detail fabrication and assemblies for support assemblies including metal framing systems, equipment supports, trapeze hangers, pipe support stands to comply with performance requirements and design criteria. Assemblies may be pre-engineered or custom designed for the application.
 - 3. Detail anchorages and attachments to structure. Where walls, floors, slabs or supplementary steel work are used for support, details of acceptable attachment methods must be included and approved before the condition is accepted for installation. Drawings must include spacing and static loads at all attachment and support points.

- C. Delegated-Design Submittal:
 - 1. Provide a delegated submittal package comprised of drawings, details, and calculations signed and sealed by an engineer specializing in the associated work and registered in Oregon. Submittals shall include device dimensions, placement, and attachment and anchorage requirements.

1.05 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

2.01 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: Pre-galvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 4. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Copper-Coated 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.

2.02 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.

2.03 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. B-line, an Eaton business
 - b. Thomas & Betts Corporation, a member of the ABB Group
 - c. Unistrut, part of Atkore International
 - 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 in-turned 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. Metallic Coating: Pre-Galvanized Hot Dipped, ASTM A653, 0.75 MIL Hot-dipped galvanized, ASTM A123 or A153, 2.6 MIL

2.04 INSULATION INSERTS

- A. General: Insulation insert for use with MSS Type 40 protection shield
- B. Insulation-Insert Material for Cold Piping:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Foamglas
 - 2. ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.
 - 3. ASTM C1126 Type III phenolic foam with factory laminated ASJ.
 - a. 1-1/2" to 2-1/2" pipe size: 32 psi at load point.

- C. Insulation-Insert Material for Hot Piping, 200 °F and less:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Insultherm
 - b. Johns Manville
 - c. Resolco, Inc.
 - 2. ASTM C1126 Type III phenolic foam with factory laminated ASJ.
 - a. Maximum Temperature: 220°F
 - b. Maximum Load:
 - 1) 1-1/2" to 2-1/2" pipe size: 32 psi at load point.
- 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.

2.05 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated 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.

2.06 ROOF MOUNTED PIPE STANDS

- A. Manufacturers subject to compliance with requirements, provide products by one of the following:
 - 1. B-Line
 - 2. Erico
 - 3. Eaton
- B. Polyethylene, polypropylene block with embedded 14-gauge hot dipped galvanized steel strut channel Similar to B-line Dura-Blok, Erico Pyramid ST.

2.07 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, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Non-staining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89Install 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-89Arrange 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. Fastener System Installation:

- 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Roof Pipe Stand Installation: Mount on smooth roof surface. Do not penetrate roof membrane.
- F. Install hangers and supports complete with necessary attachments, 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 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 Coordinate with Section 23 05 48 Vibration and Seismic Controls for interrelated work.
- J. Install building attachments within concrete slabs or to structural steel where possible. 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 that 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.
- M. Insulated Piping:
 - 1. Piping Operating less than 180 degrees:
 - a. All Piping 1-1/2-inches and Larger: Provide Insulation Insert with MSS Type 40 protection shield.
 - b. All Piping 1-1/4-inches and smaller: Provide MSS Type 40 protection shield.
 - 2. 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.
 - 3. Insulation Inserts: Same thickness as piping insulation.

3.02 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.

3.03 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.

3.04 AD USTING

- 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.

3.05 HANGER SPACING

Α.

H DRONIC PIPING SPACING TABLE	Maximum Horizontal Span	Maximum Vertical Spacing		
Carbon Steel and Stainless-steel				
1-1/4 inch and smaller	7 feet	15		
1-1/2 inch to 2-1/2 inch	10 feet	15		
3 inch and larger	12 feet	15		
Copper Tubing				
³ / ₄ inch and smaller	5 feet	10		
1 inch to 2 inch	7 feet	10		
2-1/2 inch and larger	10 feet	10		

3.06 ROD SIZES

A. Select rod diameter to not exceed the maximum safe load listed in Table 2 of MSS SP-58-2009.

3.07 HANGER AND SUPPORT TYPE SCHEDULE

- A. Single Pipe, Hung and Uninsulated
 - 1. NPS ½ to NPS 3: Adjustable Steel Band Hanger, MSS Type 7.
- B. Single Pipe, Hung and Insulated
 - 1. Operating Temperature Less Than 140 Degrees: Steel Clevis, MSS Type 1
 - 2. Operating Temperature 140 Degrees and Above.
 - a. NPS ½ to NPS2: Steel Clevis, MSS Type 1.
- C. Multiple Pipe Trapeze or Pipe Rack: Trapeze Hanger, MSS Type 59.
 - 1. Uninsulated Piping: Steel Strap.
 - 2. Insulated Piping: Adjustable Roller, MSS Type 43.
- D. Single Pipe Floor Support: Adjustable Pipe Support Saddle: MSS Type 38.
- E. Vertical Piping: Refer Section 23 05 48 Vibration and Seismic Controls for HVAC for riser support and restraint.
- F. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- G. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- H. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- I. Use copper-plated pipe hangers and attachments for copper piping and tubing.
- J. Use padded hangers for piping that is subject to scratching.
- K. To eliminate the need for seismic restraint, for piping installation where the distance from the top of the pipe to the structure is 12 inches or less for the entire run, select hanger-rod and building attachments to allow pipe movement without stress on hangers and attachments.
- L. Hanger-Rod Attachments: Unless otherwise indicated, provide 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°F piping installations.
 - 3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 - 4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450°F piping installations.
- M. Building Attachments: Unless otherwise indicated, provide 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 Ibeams for heavy loads.
- 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel Ibeams 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. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Vertical-Piping Supports: Unless otherwise required, 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.
 - 3. Refer 23 05 48 Vibration and Seismic Controls for HVAC for additional riser support requirements.
- O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications.
- P. Comply with MFMA-103 for metal framing system selections and applications.
- Q. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- R. Roof Mounted Piping: Support with Roof Mounted Pipe Stands, except where otherwise detailed on drawings.

HEAT TRACING FOR HVAC PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes heat tracing for HVAC piping with the following electric heating cables:
1. Self-regulating, parallel resistance.

1.02 ACTION SUBMITTALS

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

1.03 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.04 CLOSEOUT SUBMITTALS

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

PART 2 PRODUCTS

2.01 SELF REGULATING, PARALLEL RESISTANCE HEATING CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Delta-Therm Corporation.
 - 2. Pyrotenax; a brand of nVent.
 - 3. Raychem; a brand of nVent.
- B. Comply with IEEE 515.1.
- C. Heating Element: Pair of parallel No. 16 AWG, nickel-coated, stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled, non-heating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.
- D. Electrical Insulating Jacket: Flame-retardant polyolefin.
- E. Cable Cover: Tinned-copper braid and polyolefin outer jacket with ultraviolet inhibitor.
- F. Maximum Operating Temperature (Power On): 150°F.
- G. Maximum Exposure Temperature (Power Off): 185°F.
- H. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- I. Capacities and Characteristics:
 - 1. Refer to drawings for electrical characteristics.

2.02 CONTROLS

- A. Pipe-Mounted Thermostats for Freeze Protection:
 - 1. Remote bulb unit with adjustable temperature range from 30 to 50°F.
 - 2. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
 - 3. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.

- 4. Corrosion-resistant, waterproof control enclosure.
- B. Heat Trace Monitoring and Control System:
 - 1. Heat Trace Power Control Panel
 - a. General: Power relay control panel for control and monitoring heat trace circuits including ground-fault and line current sensing, alarming, relay switching and RTD inputs for five heat tracing circuits. UL-listed.
 - b. Enclosure: Flush mounted, NEMA 4 or 4x.
 - c. Controller: Electronic digital controller programmable from the Heat Trace Monitoring Panel
 - d. Temperature sensors: 100-ohm platinum RTD
 - e. Operating Temperature: -10°F to 120°F.
 - f. Electrical: 120 Vac,
 - g. Relays: Five, 3-pole, 30 A contactors.
 - h. Alarm Indicator: Alarm indicator lighting mounted in panel door.
 - i. Communication Port: RS-485.

2.03 ACCESSORIES

- A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.
- B. Warning Labels: Refer to Section 23 05 53 Identification for HVAC Piping and Equipment.
- C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
 - 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
 - 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 APPLICATIONS

- A. Install self-regulating, parallel-resistance heat cable for the applications described:
 - Outdoor HVAC piping that contains fluid that is subject to freezing including:
 - a. Chilled water
- B. Piping:

1.

1. The heater shall be sized as shown below. The required heater output rating is in Watts per foot at 50°F. Heater selection based on 1-inch fiberglass insulation on metal piping. PIPE SIZE TEMPERATURE -20°F

5 Watt
8 Watt
12 Watt

3.03 INSTALLATION

- A. Install electric heating cable across expansion joints according to manufacturer's written instructions; use slack cable to allow movement without damage to cable.
- B. Install electric heating cables after piping has been tested and before insulation is installed.
- C. Install electric heating cables according to IEEE 515.1.

- D. Install insulation over piping with electric cables according to Section 23 07 19 HVAC Piping Insulation.
- E. Install warning tape on piping insulation where piping is equipped with electric heating cables.
- F. Set field-adjustable switches and circuit-breaker trip ranges.

3.04 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.
- C. Cables will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.05 PROTECTION

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

3.06 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions.
- C. Inspect field-assembled components, equipment installation, piping, controls and electrical connections for proper assembly, installation, and connection.
- D. Verify that temperature sensors are calibrated. Operate each heat trace circuit. Verify circuit operating amperage.
- E. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
- F. Prepare test and inspection startup reports.

3.07 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain heat trace system.
- B. Instructor shall be factory trained and certified.
- C. Provide not less than 8 hours of training spread across consecutive days, not to exceed four hours per day.
- D. Train personnel in operation and maintenance.
- E. Provide instructional videos showing control adjustments, monitoring functions and general operation and maintenance that are coordinated with operation and maintenance manuals.
- F. Obtain Owner sign-off that training is complete.
- G. Owner training shall be held at Project site.

VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Design and installation of equipment attachment to structure, vibration isolation systems, piping riser support, and seismic restraint components listed for new mechanical equipment, ductwork, piping, and related systems provided in Division 23 as scheduled or described herein.
 - 2. Related Requirements: Seismic restraint of roof mounted equipment that will not be equipped with vibration isolation, See Section 23 05 00 General HVAC Provisions related to roof curbs, bases, and rails.

1.02 DEFINITIONS

A. OSHPD: Office of Statewide Health Planning & Development (for the State of California).

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
 - 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Shop Drawings:
 - 1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated-Design Submittal:
 - 1. Provide a delegated submittal package comprised of drawings, details, and calculations signed and sealed by an engineer specializing in the associated work and registered in Oregon. Submittals shall indicate full compliance with the device specification in Part 2. Any deviation shall be specifically noted and subject to engineer approval. Submittals shall include device dimensions, placement, and attachment and anchorage requirements.
 - 2. All restraining devices shall have a pre-approval number from California OSHPD or some other organization acceptable to the Authority Having Jurisdiction. Where pre-approved devices are not available, provide submittals based on independent testing or calculations stamped by a registered professional engineer with at least five years of seismic design experience and licensed in the state of Oregon.
 - 3. Ductwork and Piping Restraint:
 - a. Provide full or half size copies of ductwork and piping plans from the Contract Documents or coordination drawings, showing location and type of each vibration isolation component and seismic restraint to be installed. Drawings shall consist of mechanically reproduced copies of the Contract Documents, or new drawings custom drafted specifically for the Work of this Project. Each drawing shall be printed on a single sheet.

- b. Provide piping and ductwork restraint assembly construction and installation details. Assemblies may be pre-engineered or custom designed for the application.
- c. Provide spring hangers or spring floor supports for the first three supports for piping and ductwork from any equipment that produces vibration. The spring deflection shall match the equipment isolation deflection.
- d. Provide spring hangers or spring floor supports for the first three supports from any vertical riser greater than 20 feet in elevation.
- e. Where walls, floors, slabs or supplementary steel work are used for seismic restraint locations, details of acceptable attachment methods for ducts and pipe must be included and approved before the condition is accepted for installation. Restraint manufacturers' submittals must include spacing, static loads and seismic loads at all attachment and support points.
- 4. Equipment Restraint
 - a. Select vibration isolators and accessories as scheduled and as required to meet seismic restraint requirements.
 - b. Provide equipment seismic restraint assembly construction and installation details. Assemblies may be pre-engineered or custom designed for the application. Include method of attachment to supporting structure.
 - c. Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.
 - d. For equipment mounted outdoors, include wind load in determining the necessary attachment and restraint requirements.
- 5. Calculations: Provide design calculations to verify that seismic and wind load restraint will comply with the current Oregon Structural Specialty Code for the site and the building type listed.
- 6. 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, seismic loads, and location of spring hangars needed to ensure piping and ductwork is properly supported throughout. Include certification that riser system was examined for excessive stress and that none exists.

1.04 INFORMATIONAL SUBMITTALS

- A. Provide three copies of the seismic restraint system Engineer's inspection report.
- B. Provide a written authorization letter from the seismic restraint Engineer authorizing a representative to provide the inspection if a designated representative is used. Describe the representative's qualifications.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Provide seismic and wind load design in accordance with the current Oregon State Structural Specialty Code and ASCE/SEI 7.
- B. Refer to structural notes for project specific seismic requirements.
- C. Risk Category: IV
- D. Component Importance Factor (Ip)
 - 1. As required by Code, except as listed below
 - 2. Components with an Ip 1.5.
 - a. All mechanical systems including duct, hydronic piping, DOAS unit, exhaust fans, pumps, boilers, and chilled beams shall have their attachments to the building designed with a component importance factor of 1.5. Certification of equipment by the manufacturer is not required.

2.02 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads: (EP-1)
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Kinetics Noise Control, Inc.
- b. Mason Industries, Inc.
- c. Vibro-Acoustics
- 2. Basis of Design: Mason Type Super WM Pads.
- 3. Fabrication: Neoprene waffle pad. 3/4-inch thick. 40 durometer. ¼-inch thick steel load distribution plate
- 4. Size: Factory or field cut to match requirements of supported equipment.
- 5. Accessories: Bolt isolator washer bushings where equipment is bolted to structure. Similar to Mason Type HG

2.03 FREE STANDING SPRING MOUNTS

- A. Laterally Stable, Open-Spring Mount: (SM-1).
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibro-Acoustics
 - 2. Basis of Design: Mason Industries Type SLF
 - 3. General: Free-standing spring isolators. Laterally stable without housing. Complete with molded neoprene cup or ¼-inch neoprene acoustical friction pad between the baseplate and the support.
 - 4. Provided with leveling bolts rigidly bolted to the equipment.
 - 5. Spring diameters not less than 80% of the spring height at rated load.
 - 6. Minimum additional travel to solid equal to 50% of the rated defection.
- B. Freestanding, Seismically Restrained, Open-Spring Isolators: (SM-2)
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibro-Acoustics
 - 2. Basis of Design: Mason Industries Type SSLFH
 - 3. Free standing laterally supported with neoprene cup or ¼ inch neoprene acoustical friction pads between spring and support. Leveling bolts.
 - 4. Spring diameter no less than 80 percent of the compressed height of the spring at rated load.
 - 5. Spring to have an additional minimum travel to solid equal to 50 percent of the rated deflection.
 - 6. Ductile iron or steel housing to resist motion due to earthquake loads in all directions. Minimum 0.5 G rating.
 - 7. Minimum clearance of ¼-inch to be maintained between the restraining bolts and a molded neoprene bushing so as not to interfere with spring action
 - 8. The housing shall be out of contact during normal operating.
 - 9. Deflection as scheduled.
- C. Freestanding, Seismically and Vertically Restrained, Open-Spring Isolators: (SM-3)
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibro-Acoustics
 - 2. Basis of Design: Mason Industries Type SLR or SLRS
 - 3. Free standing springs, laterally stable and complete with a molded neoprene cup or 1/4" neoprene acoustical friction pad between the spring and the mounting baseplate.
 - 4. Spring diameter no less than 80 percent of the compressed height of the spring at rated load.

- 5. Spring to have an additional minimum travel to solid equal to 50 percent of the rated deflection.
- 6. Mount housing shall include vertical limit stops to prevent spring extension when weight is removed.
- 7. All restraining bolts shall have large rubber grommets to provide cushioning in the vertical and horizontal directions.
- 8. A minimum clearance of ¼-inch shall be maintained around restraining bolts so as not to interfere with the spring action.
- 9. Mountings shall have an Anchorage Preapproval Number from OSHPD in the State of California certifying the maximum certified horizontal and vertical load ratings.

2.04 PIPE RISER RESILIENT SUPPORT

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Kinetics Noise Control, Inc.
 - 2. Mason Industries, Inc.
- B. Basis of Design: Mason Industries Type ADA.
- C. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- thick neoprene.
 - 1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
 - 2. Maximum Load Per Support: 500 psig isolation material providing equal isolation in all directions.

2.05 PIPE RISER RESILIENT GUIDES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Kinetics Noise Control, Inc.
 - 2. Mason Industries, Inc.
- B. Basis of Design: Mason Industries Type VSG
- C. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch- thick neoprene.
 - 1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and re-insertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.
 - 2. Include steel and neoprene vertical limit stops arranged to prevent vertical travel in both directions.
 - 3. Design support of a maximum load on the isolation material of 500 psig and for equal resistance in all directions.

2.06 SPRING HANGERS

- A. Spring and Neoprene Hanger with Vertical Restraint: (SH-1)
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibro-Acoustics
 - 2. Basis of Design: Mason Industries Type RW30N
 - 3. 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.
 - 4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

- 7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- 8. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
- 9. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
- 10. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.07 RESTRAINT CHANNEL BRACINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. B-line, an Eaton business.
 - 2. Hilti, Inc.
 - 3. Mason Industries, Inc.
 - 4. Vibro-Acoustics
- B. Basis of Design: Mason Industries SSBS/SHB
- C. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end. Provide other matching components. Corrosion-resistant coating; rated in tension, compression, and torsion forces.
- D. Accessories:
 - 1. Neoprene clamp cushion. Similar to Unistrut, Cush-A-Clamp

2.08 RESTRAINT CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Kinetics Noise Control, Inc.
 - 2. Mason Industries, Inc.
 - 3. Vibro-Acoustics
- B. Basis of Design: Mason Industries SCB/H
- C. Restraint Cables: ASTM A 603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.09 MECHANICAL ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. B-line, an Eaton business
 - 2. Hilti, Inc.
 - 3. Kinetics Noise Control, Inc.
 - 4. Mason Industries
 - 5. Vibro-Acoustics
- B. Basis of Design: Mason Industries SASE, SAST
- C. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.10 ADHESIVE ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hilti, Inc.
 - 2. Kinetics Noise Control, Inc.
 - 3. Mason Industries
 - 4. Vibro-Acoustics

- B. Basis of Design: Mason Industries SRA
- C. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.11 SEISMIC RESTRAINT ACCESSORIES

- A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.
- B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.
- D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.
- E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

PART 3 EXECUTION

3.01 GENERAL

- A. Coordinate locations and sizes of structural supports with locations of vibration isolators and seismic/wind restraints (e.g., roof curbs, air-cooled chillers, etc.).
- B. Isolated and restrained equipment, duct and piping located on roofs must be attached to the structure. Intermediate supports between the restraint and structure that are not attached to the structure must be approved the project structural engineer or by the restraint manufacturer.
- C. Block and shim all bases level so that all ductwork, piping and electrical connections can be made to a rigid system at the proper operating level, before isolators are adjusted. Ensure that there are no rigid connections or incidental physical contacts between isolated equipment and the building structure or nearby systems.
- D. Ensure housekeeping pads have adequate space to mount equipment and isolator housings and shall also be large enough to ensure adequate edge distance for isolator anchors to prevent breakout.
- E. Select and locate vibration isolation equipment to give uniform loading and deflection, according to weight distribution of equipment.

3.02 EXAMINATION

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

3.03 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on seismic design documents to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.04 VIBRATION CONTROL AND SEISMIC RESTRAINT DEVICE INSTALLATION

- A. Install all equipment in accordance with manufacturer's recommendations and as shown on seismic design documents.
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Elastomeric Isolation Pads: Provide for entire weight bearing surface of equipment base, or as recommended by equipment manufacturer.
- D. Equipment Restraints:
 - 1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- E. Ductwork Restraints:
 - 1. Space lateral supports a maximum of 40 feet on center and longitudinal supports a maximum of 80 feet on center.
 - 2. Brace a change of direction longer than 12 feet.
 - 3. Provide spring hangers supports for the first three supports from any equipment that produces vibration.
- F. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of 40 feet on center and longitudinal supports a maximum of 80 feet on center.
 - 3. Brace a change of direction longer than 12 feet.
 - 4. Provide spring hangers or spring floor supports for the first three supports from any equipment that produces vibration.
 - 5. Provide spring hangers or spring floor supports for the first three supports from any vertical riser 1-1/2 inch and larger and greater than 20 feet in elevation.
- G. Install cables so they do not bend across edges of adjacent equipment or building structure.
- H. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- I. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- J. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- K. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- L. Drilled-in Anchors:
 - Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

- 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
- 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
- 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
- 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.05 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Equipment Piping Connection:
 - 1. Provide flexible pipe connectors at all equipment connections to allow seismic motion of piping relative to equipment. Refer to Section 23 21 16 Hydronic Specialties.
 - 2. Provide equipment connectors for all motor driven equipment and components connected to such equipment.
 - 3. Provide equipment connectors for non-motor drive equipment as detailed and as otherwise specified.
 - 4. Flexible connectors as listed in Section 23 21 16 Hydronic Specialties must be selected to allow seismic movement without exceeding acceptable nozzle loads on equipment connections. Acceptable nozzle loads provided by manufacturer.
 - 5. Install flexible pipe connectors and hoses on the equipment side of shutoff valves.

3.06 FIELD QUALITY CONTROL

- A. After installation of seismic and vibration control devices is complete and verified as fully functional, Contractor shall notify Engineer and seismic restraint designer that equipment is ready for inspection.
- B. Seismic restraint system Engineer shall inspect the installation to verify that seismic restraints are installed and adjusted in conformance with approved shop drawings and no additional restraints are necessary based on field conditions. Alternately, the restraint system Engineer may designate a qualified representative to provide the inspection. The representative may not be an employee of the installing Contractor or Subcontractor.
- C. Prepare inspection reports.

3.07 AD USTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
3.08 HVAC VIBRATION CONTROL AND SEISMIC RESTRAINT DEVICE SCHEDULE

Α.

VIBRATION ISOLATION AND SEISMIC RESTRAINT SCHEDULE					
EQUIPMENT	SPECIFICATION	SLAB ON GRADE	ABOVE GRADE		
		STATIC DEFLECTION	STATIC DEFLECTION		
Pumps	Elastomeric Isolation Pads EP-1 Flexible connectors	N/A	N/A		
Condensing Unit	Elastomeric Isolation Pads EP-1	N/A	N/A		
Chillers	Restrained Spring Isolator SM-3 Elastomeric Isolation Pad EP-1 Flexible connectors	N/A	1.5"		
Rooftop Air Conditioning Units (Up to 20 Ton)	Elastomeric Isolation Pad EP-1 Roof-curb rails	NA	N/A		
Exhaust Fans	Elastomeric Isolation Pads EP-1	N/A	N/A		
Fan Coils	Spring Hanger SH-1	N/A	0.75"		
Unit Heater	Spring Hanger SH-1	N/A	0.75"		

END OF SECTION

SECTION 23 0553

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Pipe labels.
 - 3. Valve tags.

1.02 ACTION SUBMITTALS

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

1.03 COORDINATION

A. Coordinate with Division 22. Match manufacturer, type, and style of identification used.

PART 2 PRODUCTS

2.01 GENERAL

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Brady Corporation.
 - 2. Marking Services, Inc.
 - 3. Seton Identification Products.

2.02 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: 0.025-inch aluminum. Predrilled or stamped holes for attachment hardware.
 - 2. Letter Color: Black.
 - 3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 4. 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-quarters the size of principal lettering.
 - 5. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 6. 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. Engraved to show white lettering on black background except for labels attached to ceiling grid or located within finished spaces shall have black lettering on white background.
 - 3. Maximum Temperature: Able to withstand temperatures up to 160°F.
 - 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 5. 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-quarters the size of principal lettering. Lettering on labels attached to ceiling grid largest size practical.

- 6. Fasteners: Stainless-steel rivets or self-tapping screws.
- 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number.
- D. Equipment Label Schedule: For each item of equipment to be labeled, prepare equipment label schedule 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) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.03 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.
- B. Pre-tensioned Pipe Labels: Pre-coiled, semi-rigid 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; also include 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: Size letters according to ASME A13.1 for piping.

2.04 VALVE TAGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Brady Corporation.
 - 2. Marking Services Inc.
 - 3. Seton Identification Products.
- B. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Polished brass, 0.025-inch aluminum and having predrilled or stamped holes for attachment hardware.
 - 2. Minimum Tag Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4-inch.
 - 3. Fasteners: Brass wire-link chain or S-hook.
- C. 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.

PART 3 EXECUTION

3.01 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.

3.02 GENERAL INSTALLATION REQUIREMENTS

- 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.

D. Ceiling Grids and Access Openings: Label ceiling grid and wall/ceiling access doors and to indicate key access points for equipment, valves, control devices and other components requiring quick access or routine maintenance. Provide a clear adhesive label and bold black lettering with component identification information, except where Owner has an established identification standard label in accordance with Owner's standards. Place label on ceiling metal grid and not on removable tiles.

3.03 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.04 PIPE LABEL INSTALLATION

- A. Piping Color Coding: Painting of piping is specified in Division 09.
- B. Pipe Label Locations: 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 and on both sides of 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.
- C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- D. Pipe Label Color Schedule: Letter and background color in accordance with ANSI A13.1.

3.05 VALVE TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, faucets, convenience and lawn-watering hose connections, and isolation valves for 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 with captions as indicated in the following subparagraphs:
 - 1. Valve-Tag Information: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch valve tag numbers.

END OF SECTION

SECTION 23 0593

TESTING, AD USTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Balancing air systems and equipment.
 - 2. Balancing hydronic piping systems and equipment.
 - 3. Control system measurement and verification.

1.02 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. BAS: Building automation systems.
- C. NEBB: National Environmental Balancing Bureau.
- D. TAB Specialist: An independent entity meeting qualification to perform TAB work.
- E. TAB Project Supervisor: Certified individual employed by balancing contractor having administrative and technical responsibility for work performed under this Section.
- F. TAB: Testing, adjusting, and balancing.

1.03 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 15 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in Part 1 "Quality Assurance" and Part 3 "TAB Specialist."
- B. System Readiness Checklists: Within 60 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.
- C. Instrument Calibration Report: Within 60 days of Contractor's Notice to Proceed. Report to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.
 - 5. Dates of calibration.
- D. TAB reports.
 - 1. Draft TAB Report
 - 2. Certified Final TAB report.
 - 3. Verification of TAB Report

1.04 QUALITY ASSURANCE

- A. All work under this Section shall be performed under the direction of the Certified TAB Supervisor.
- B. TAB Specialists Qualifications: Certified by AABC or NEBB.
 - 1. TAB Supervisor: Employee of the TAB specialist and certified by AABC or NEBB.
 - 2. TAB Technician: Employee of the TAB specialist working under the supervision of the TAB Supervisor.
- C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

PART 2 PRODUCTS Not Applicable

PART 3 EXECUTION

3.01 TAB SPECIALISTS

- A. Subject to compliance with requirements, engage one of the following:
 - 1. Air Balancing Specialties.

- 2. Air Introduction and Regulation, Inc.
- 3. Neudorfer Engineering, Inc.
- 4. Southern Oregon Engineering Services, Inc.

3.02 EXAMINATION

- A. Contract Document Examination:
 - 1. 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.
 - 2. Confirm that balancing devices and provisions are included to facilitate TAB work. Provide listing of any devices and provisions required that are on included in the Contact Documents.
 - 3. Contract Documents Examination Report: Based on examination of the Contract Documents, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Construction Examination:
 - 1. Examine the approved submittals for HVAC systems and equipment.
 - 2. Examine installed systems for 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 applicable for intended purpose and are accessible.
 - 3. 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.
 - 4. Examine test reports specified in individual system and equipment Sections.
 - 5. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
 - 6. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.
 - 7. Examine control valves for proper installation and orientation for their intended function of throttling, diverting, or mixing fluid flows. Verify the pipe connections are in accordance with manufacturers recommendations.
 - 8. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
 - 9. Examine system pumps to ensure absence of entrained air in the suction piping.
 - 10. 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.

3.03 PREPARATION

- A. Strategies and Procedures Plan: Prepare a TAB plan that includes the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.
- B. Prepare system-readiness checks of HVAC systems and equipment to be executed by the Mechanical Contractor to verify system readiness for TAB work. Include, at a minimum, the following:
 - 1. Airside:
 - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
 - b. Duct systems are complete with terminals installed.
 - c. Volume, smoke, and fire dampers are open and functional.
 - d. Clean filters are installed.

- e. Fans are operating, free of vibration, and rotating in correct direction.
- f. Variable-frequency controllers' startup is complete, and safeties are verified.
- g. Automatic temperature-control systems are operational.
- h. Ceilings are installed.
- i. Windows and doors are installed.
- j. Suitable access to balancing devices and equipment is provided.
- 2. Hydronics:
 - a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
 - b. Piping is complete with terminals installed.
 - c. Water treatment is complete.
 - d. Systems are flushed, filled, and air purged.
 - e. Strainers are pulled and cleaned.
 - f. Control valves are functioning per the sequence of operation.
 - g. Shutoff and balance valves have been verified to be 100 percent open.
 - h. Pumps are started and proper rotation is verified.
 - i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
 - j. Variable-frequency controllers' startup is complete, and safeties are verified.
 - k. Suitable access to balancing devices and equipment is provided.

3.04 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
 1. Comply with requirements in ASHRAE 62.1, "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, install test ports and duct access doors as required in Section 23 33 00 Air Duct Accessories. Otherwise, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 23 07 13 – Duct Insulation, Section 23 07 16 – HVAC Equipment Insulation, and Section 23 07 19 – 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.

3.05 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check 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 exhaustair dampers through the supply-fan discharge and mixing dampers.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.

- J. Check for proper sealing of air-handling-unit components.
- K. Verify that air duct system is sealed as specified in Section 23 31 13 Metal Ductwork.
- L. Fan Pressure Measurements:
 - 1. Measure static pressure directly at the fan outlet or through the flexible connection.
 - 2. Measure static pressure directly at the fan inlet or through the flexible connection.
 - 3. Measure static pressure across each component that makes up and air-handling system.
- M. Air Inlets and Outlets:
 - 1. Supply Diffusers: Set airflow patterns of adjustable outlets for proper distribution without drafts.
- N. Control Parameters and Setpoints:
 - 1. Minimum Ventilation Rates: Measure and adjust outside-air, return-air, and relief-air dampers for proper position to achieve minimum outdoor-air conditions. Determine setpoint values for specific control sequences controlling damper operation.
 - 2. Airflow Transmitters: Perform field verification and calibration of BAS airflow flow transmitters. Airflow verification shall be performed by duct traverse in straight section of ductwork to provide measurement accuracy of /- 5%.
 - 3. Record verification measurement. calibration parameters, and setpoints in Final TAB Report.

3.06 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:
 - 1. Measure and adjust expansion tank bladder pressure. Measure bladder pressure with system isolation valve closed and vent valve open to remove system pressure from bladder. Adjust bladder pressure to 2 psig greater than that make-up water pressure indicated on drawings. Document bladder pressure in final TAB report.
 - 2. Check highest vent for adequate pressure.
 - 3. Check flow-control valves for proper position.
 - 4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
 - 5. Verify that motor starters are equipped with properly sized thermal protection.
 - 6. Check that air has been purged from the system.
- E. Flow Adjustments:
 - 1. Perform temperature tests after flows have been balanced.
 - 2. Position 3-way control valves to bypass the coil and adjust the bypass valve to maintain design flow.
 - 3. For pressure independent flow devices, measure differential pressure and verify that it is within manufacturer's specified range.
 - 4. Adjust memory stops on balancing devices.
- F. Pump Pressure Measurements:
 - 1. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
 - 2. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
 - 3. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

- G. Control Parameters and Setpoints:
 - 1. Water Flow Transmitters: Perform field verification and calibration of BAS water flow transmitters. Water flow verification shall be performed to provide measurement accuracy of /- 2 % or as scheduled on drawings.
- H. Record verification measurement. calibration parameters, and setpoints in Final TAB Report.

3.07 PROCEDURES FOR CHILLERS

- A. Balance water flow through each evaporator to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
 - 1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
 - 2. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
 - 3. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
 - 4. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
 - 5. Capacity: Calculate in tons of cooling.
 - 6. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.08 PROCEDURES FOR BOILERS

- A. Hydronic Boilers:
 - 1. Measure and record entering- and leaving-water temperatures.
 - 2. Measure and record water flow.
 - 3. Record relief valve pressure setting.

3.09 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 for major (more than 20 gpm) equipment coils, excluding unitary equipment such as reheat coils, unit heaters, and fan-coil units.
 - 4. Dry-bulb temperature of entering and leaving air.
 - 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 - 6. Airflow.
- 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.
 - 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 refrigerant coil:
 - 1. Dry-bulb temperature of entering and leaving air.
 - 2. Wet-bulb temperature of entering and leaving air.
 - 3. Airflow.

1

3.10 PROCEDURES FOR MOTORS

- A. Motor Measurement and Verification:
 - Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - a. Manufacturer's name, model number, and serial number.
 - b. Motor horsepower rating.
 - c. Motor rpm.
 - d. Phase and hertz.
 - e. Nameplate and measured voltage, each phase.
 - f. Nameplate and measured amperage, each phase.

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- g. Starter size and thermal-protection-element rating.
- h. Service factor and frame size.
- 2. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.
- B. Motor Speed Adjustments:
 - 1. Obtain approval from Engineer for adjustment of fan motor speeds higher than the motor synchronous speed. indicated speed for induction motors
 - 2. Obtain approval from Engineer prior to making fan-speed adjustments that result in motor operation above the motor RLA. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required motor amperage.

3.11 CONTROLS VERIFICATION

- A. In conjunction with system balancing, perform the following:
 - 1. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.
 - 2. Verify that the system static pressure sensor is located in the duct or piping system as specified or as shown on drawings.
 - 3. Verify the operation of valve and damper actuators. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
- B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions in Final Report.

3.12 TOLERANCES

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 10 percent or minus 5 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.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.13 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
 - 3. Certify validity and accuracy of field data.
- 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. Test reports shall be fully executed reports forms confirming to standard NEBB or AABC documentation standards.
 - 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 specialist.
 - 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. Settings for supply-air, static-pressure controller.
 - g. 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. Instrument Calibration Reports:
 - 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

END OF SECTION

SECTION 23 0713

DUCT INSULATION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes insulation of HVAC ductwork.

1.02 ACTION SUBMITTALS

A. Provide submittals in accordance with Section 23 05 00 – General HVAC Provisions as follows:
 1. Provide catalog data for all products. Indicate thermal conductivity, water vapor permeance, and jackets (both factory and field applied) if any.

1.03 QUALITY ASSURANCE

- A. Insulation materials and accessories shall be installed in a professional manner by skilled and experienced workers who specialize in commercial insulation work.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.04 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.

1.05 COORDINATION

A. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.06 SCHEDULING

A. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS

2.01 INSULATION MATERIALS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. 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.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. 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 III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation
 - b. Johns Manville, a Berkshire Hathaway company
 - c. Knauf Insulation

- F. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation
 - b. Johns Manville, a Berkshire Hathaway company
 - c. Knauf Insulation

2.02 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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- C. FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

2.03 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
 - 1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 2. Service Temperature Range: Minus 20 to plus 180°F.
 - 3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 - 4. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
 - 1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 - 2. Service Temperature Range: Minus 50 to plus 220°F.
 - 3. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 - 4. Color: White.

2.04 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
 - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 2. Fire- and water-resistant, flexible, elastomeric sealant.
 - 3. Service Temperature Range: Minus 40 to plus 250°F.
 - 4. Color: Aluminum.

2.05 FACTORY APPLIED ACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with Kraft paper backing; complying with ASTM C 1136, Type II.

2.06 FIELD APPLIED ACKETS

- A. Self-Adhesive Outdoor Jacket:
 - 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. PolyGuard, Alumaguard.
 - 2. Description: 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with aluminum-foil facing.

2.07 **TAPES**

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 - 1. Width: 3 inches.
 - 2. Thickness: 6.5 mils.
 - 3. Adhesion: 90 ounces force/inch in width.
 - 4. Elongation: 2 percent.
 - 5. Tensile Strength: 40 lbf/inch in width.
 - 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 - 1. Width: 2 inches.
 - 2. Thickness: 3.7 mils.
 - 3. Adhesion: 100 ounces force/inch in width.
 - 4. Elongation: 5 percent.
 - 5. Tensile Strength: 34 lbf/inch in width.

2.08 SECUREMENTS

- A. Insulation Pins and Hangers:
 - 1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - 2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - 3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - b. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inchdiameter shank, length to suit depth of insulation indicated.
 - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 - 4. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - b. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inchdiameter shank, length to suit depth of insulation indicated.
 - c. Adhesive-backed base with a peel-off protective cover.
 - 5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel or aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
 - 6. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inchthick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

- 1. Verify that systems to be insulated have been tested and are free of defects.
- 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.03 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces, free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct 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. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. 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.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.04 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
- D. Insulation Installation at Floor Penetrations:
 - 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 - 2. Seal penetrations through fire-rated assemblies.

3.05 INSTALLATION OF MINERAL FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, and manufacturer's recommended percent coverage of duct and plenum surfaces.
 - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 - 3. Install support pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over-compress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 - 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vaporbarrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50°F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

- 5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
- 6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for manufacturer's recommended percent coverage of duct and plenum surfaces.
 - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 - 3. Install support pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over-compress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 - 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vaporbarrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50°F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
 - 5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 - 6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.06 FIELD APPLIED ACKET INSTALLATION

A. 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 (300 mm) o.c. and at end joints.

3.07 FIELD QUALITY CONTROL

- A. Testing Agency: Owner reserves the right to perform tests and inspections.
- B. Tests will include removing field-applied jacket and insulation in layers in reverse order of their installation for each duct system schedule as directed by the Owner.

C. If sample inspection reveals noncompliance with requirements, all similar insulation applications will be considered defective Work and will be replaced at no expense to the Owner.

3.08 DUCT INSULATION SCHEDULE

- A. Insulate all plenums and ductwork as scheduled with the following exceptions.
 - 1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 - 2. Factory-insulated flexible ducts.
 - 3. Factory-insulated plenums and casings.
 - 4. Flexible connectors.
 - 5. Vibration-control devices.
 - 6. Factory-insulated access panels and doors.
- B. Insulate ductwork located indoors in conditions spaces:
 - 1. Supply Air.

f.

- a. Insulate ductwork where the air supply temperature is:
 - 1) More than 10°F below that space cooling temperature setpoint or below 60°F.
 - 2) More than 15°F above the space heating temperature setpoint.
- b. Exposed rectangular ductwork:
 - 1) Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density, PSP jacket.
- c. Exposed round or oval ductwork:
 - 1) Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density, PSP jacket.
- d. Concealed ductwork:
 - 1) Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density, FSK jacket.
- e. Mechanical rooms, more than 8 feet above finished floor:
 - 1) Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density, FSK jacket.
 - 2) Mineral-Fiber board, 1-1/2 inches thick and 3-lb/cu. ft. nominal density.
 - Mechanical rooms, less than 8 feet above finished floor:
 - 1) Mineral-Fiber board, 1-1/2 inches thick and 3-lb/cu. ft. nominal density.
- 2. Exhaust ductwork requiring condensation control including exhaust ductwork from showers, dishwashers, washdown areas, and similar applications that produce exhaust with high moisture content.
 - a. Insulate same as insulated supply air ductwork.
- C. Insulate supply and return ductwork located indoors in unconditioned spaces, or inside a wall between a conditioned and unconditioned space.
 - 1. Supply and Return Air:
 - a. Mineral-Fiber Blanket: 3 inches (50 mm) thick and 0.75-lb/cu. ft. nominal density, FSK jacket.

3.09 OUTDOOR, FIELD APPLIED ACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the fieldapplied jacket over the factory-applied jacket.
 - 1. Ducts and Plenums, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
 - 2. Self-Adhesive Outdoor Jacket

END OF SECTION

SECTION 23 0716

HVAC EQUIPMENT INSULATION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes insulation of HVAC equipment

1.02 ACTION SUBMITTALS

A. Provide submittals in accordance with Section 23 05 00 – General HVAC Provisions as follows:
 1. Provide catalog data for all products. Indicate thermal conductivity, water vapor permeance, and jackets (both factory and field applied) if any.

1.03 QUALITY ASSURANCE

- A. Insulation materials and accessories shall be installed in a professional manner by skilled and experienced workers who specialize in commercial insulation work.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products listed and labeled in accordance with UL 723 or according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.04 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.

1.05 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 Hangers and Supports for HVAC Piping and Equipment.
- B. Coordinate clearance requirements with equipment Installer for equipment insulation application.
- C. Coordinate installation and testing of heat tracing.

1.06 SCHEDULING

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

PART 2 PRODUCTS

2.01 INSULATION MATERIALS

- A. Comply with requirements in "Breeching Insulation Schedule" and "Equipment 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. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials. UL Classified to UL 723 at 25/50.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armacell LLC.
 - b. Aeroflex USA, Inc.
- E. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. Provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
- F. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb./cu. ft. or more. Thermal conductivity (k-value) at 100°F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
- G. Pre-manufactured Removable Insulation Systems
 - 1. General: Removable and Re-useable insulation covers, custom engineered and manufactured for the specific application. Similar to Fit Tight Covers.
 - 2. Construction
 - a. Jacket and Liner: Silicon Impregnated Fiberglass Fabric
 - b. Insulation: 1-inch Type E Glass Mat
 - c. Fastening: 1-inch straps and stainless-steel D-rings.
 - d. Thread: Kevlar/stainless steel thread.

2.02 ADHESIVES

- A. Materials compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armacell LLC.
 - b. Aeroflex USA, Inc.
 - c. Foster Brand; H. B. Fuller Construction Products.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- D. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.

2.03 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
- B. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
 - 1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
 - 2. Service Temperature Range: 0 to 180°F.
 - 3. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
 - 4. Color: White.

- C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
 - 1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 - 2. Service Temperature Range: Minus 50 to plus 220°F.
 - 3. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 - 4. Color: White.

2.04 FACTORY APPLIED ACKETS

- 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.

2.05 FIELD APPLIED ACKETS

- 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. P.I.C. Plastics, Inc.
 - c. Proto Corporation.
 - 2. Adhesive: As recommended by jacket material manufacturer.
 - 3. Color: White.
 - 4. Factory-fabricated tank heads and tank side panels.

2.06 **TAPES**

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Width: 3 inches.
 - 2. Thickness: 11.5 mils.
 - 3. Adhesion: 90 ounces force/inch in width.
 - 4. Elongation: 2 percent.
 - 5. Tensile Strength: 40 lbf/inch in width.
 - 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
 - 1. Width: 2 inches.
 - 2. Thickness: 6 mils.
 - 3. Adhesion: 64 ounces force/inch in width.
 - 4. Elongation: 500 percent.
 - 5. Tensile Strength: 18 lbf/inch in width.

2.07 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems and equipment 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.

3.02 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment 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. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. 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 insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. 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.
 - Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints.

- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. 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.
- O. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.04 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

- A. Mineral-Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area.
 - 2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 - 3. Protect exposed corners with secured corner angles.
 - 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
 - d. Do not over-compress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 - 5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
 - 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch pre-stressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
 - 7. Stagger joints between insulation layers at least 3 inches.
 - 8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
 - 9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
 - 10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
 - 1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 - 2. Seal longitudinal seams and end joints.
 - 3. Installation shall follow the manufacturer's installation instructions or ASTM C 1710.

3.05 FIELD APPLIED ACKET INSTALLATION

- A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.06 FIELD QUALITY CONTROL

- A. Testing: The Owner reserves the right to perform tests and inspections of selected insulation sites at Owner's cost for testing and repair.
- B. Tests will include removing field-applied jacket and insulation in layers in reverse order of their installation for each piping system scheduled. If testing reveals defective work, all similar insulation sites will be considered defective, and Contractor will be responsible for cost of inspection and repair for all such sites.

3.07 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment that is not factory insulated as scheduled.
- C. Chillers: Insulate cold surfaces on chillers, including, but not limited to, evaporator bundles, condenser bundles, suction piping, compressor inlets, tube sheets, water boxes, and nozzles with one of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
- D. Pump Housing:
 - 1. Fluid operating temperature 100°F and above:
 - a. Pre-manufactured Removable Insulation Systems
 - 2. Fluid operating temperature 55°F and below shall be one of the following:
 - a. Pre-manufactured Removable Insulation Systems
 - b. Flexible Elastomeric: 1 inch thick.
- E. Chilled-water air-separator insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Pipe and Tank: 1 inch thick.
- F. Heating-hot-water air-separator insulation shall be the following:
 - 1. Mineral-Fiber Pipe and Tank: 2 inches thick.

3.08 INDOOR, FIELD APPLIED ACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the fieldapplied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Equipment, Concealed:
 - 1. None.
- D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
 - 1. None.
 - 2. PVC: 20 mils thick.

3.09 OUTDOOR, FIELD APPLIED ACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the fieldapplied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Equipment, Concealed:
 - 1. None.
 - 2. PVC: 20 mils thick.

END OF SECTION

SECTION 23 0719

HVAC PIPING INSULATION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes insulating of above grade HVAC piping.

1.02 ACTION SUBMITTALS

- A. Provide submittals for products listed in the Product Table below in accordance with Section 23 05 00 General HVAC Provisions.
 - 1. Catalog Data.
 - 2. For each type of product listed, provide thermal conductivity and water-vapor permeance.

1.03 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.04 QUALITY ASSURANCE

- A. Insulation materials and accessories shall be installed in a professional manner by skilled and experienced workers who specialize in commercial insulation work.
- B. Surface-Burning Characteristics: Products shall have flame spread and smoke developed ratings based on test procedures and listed and labeled in accordance with NFPA-255 and UL 723. Rating shall be indicated on the product or on the shipping containers.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.05 DELIVERY, STORAGE, AND HANDLING

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

1.06 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 Hangers and Supports for HVAC Piping and Equipment.
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.07 SCHEDULING

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

PART 2 PRODUCTS

2.01 INSULATION MATERIALS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. 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.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. Insulation jacket material shall be paintable where painting of the insulation jacket is specified.
- 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Pittsburg Corning Corporation
 - 2. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
 - 3. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
- H. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville, a Berkshire Hathaway company
 - b. Knauf Insulation
 - c. Manson Insulation Inc.
 - d. Owens-Corning.
 - 2. Type I, 850°F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- I. Pre-manufactured Removable Insulation Systems
 - 1. General: Removable and Re-useable insulation covers, custom engineered and manufactured for the specific application. Similar to Fit Tight Covers.
 - 2. Construction
 - a. Jacket and Liner: Silicon Impregnated Fiberglass Fabric
 - b. Insulation: 1-inch Type E Glass Mat
 - c. Fastening: 1-inch straps and stainless-steel D-rings.
 - d. Thread: Kevlar/stainless steel thread.

2.02 ADHESIVES

- A. Materials compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800°F.
- C. Flexible Elastomeric: Comply with MIL-A-24179A, Type II, Class I.
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- E. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
- F. PVC Jacket Adhesive: Compatible with PVC jacket.

2.03 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

- 1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
- 2. Service Temperature Range: Minus 20 to plus 180°F.
- 3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
- 4. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
 - 1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 - 2. Service Temperature Range: Minus 50 to plus 220°F.
 - 3. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 - 4. Color: White.

2.04 FACTORY APPLIED ACKETS

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

2.05 FIELD APPLIED ACKETS

- 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville, a Berkshire Hathaway company
 - b. P.I.C. Plastics, Inc.
 - c. Proto Corporation
 - 2. Adhesive: As recommended by jacket material manufacturer.
 - 3. Color: White Color-code jackets based on system. Color as selected by Architect .
 - 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. ITW Insulation Systems; Illinois Tool Works, Inc.
 - 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and Kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 2.5-mil- thick polysurlyn.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.06 **TAPES**

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Width: 3 inches.
 - 2. Thickness: 11.5 mils.
 - 3. Adhesion: 90 ounces force/inch in width.
 - 4. Elongation: 2 percent.
 - 5. Tensile Strength: 40 lbf/inch in width.
 - 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
 - 1. Width: 2 inches.
 - 2. Thickness: 6 mils.
 - 3. Adhesion: 64 ounces force/inch in width.
 - 4. Elongation: 500 percent.
 - 5. Tensile Strength: 18 lbf/inch in width.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 - 1. Width: 2 inches.
 - 2. Thickness: 3.7 mils.
 - 3. Adhesion: 100 ounces force/inch in width.
 - 4. Elongation: 5 percent.
 - 5. Tensile Strength: 34 lbf/inch in width.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. 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.
- C. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- D. Install multiple layers of insulation with longitudinal and end seams staggered.
- E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. 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.
- J. Where piping connections, accessories, or control components are attached to piping with an operating temperature less than 60°F, insulate piping and projections where condensation may occur.
 - 1. Piping that has constant or intermittent flow: Insulate to match connected piping.
 - 2. Piping that does not have fluid flow including connections, nipple, wells or other accessories that penetrate insulation and are constructed from materials other than stainless steel, copper, brass, or plastic shall be insulation up to connected devices including pressure relief valves, field mounted control devices, pressure sensing tubing.
- K. Apply insulation and jacket manufacturer approved adhesives, mastics, and sealants at 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 4 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. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.04 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. 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 23 05 00 General HVAC Provisions for firestopping and fire-resistive joint sealers.
- D. 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 23 05 00 General HVAC Provisions.

3.05 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover for removable basket flange. 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. 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 at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 - 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 - 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 - 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.06 INSTALLATION OF 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.

3.07 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Installation shall follow the manufacturer's installation instructions or ASTM C 1710.
- C. Insulation Installation on Pipe Flanges:
 - 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 - 2. Install pipe insulation to outer diameter of pipe flange.
 - 3. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - 4. 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.
 - 5. 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.
- D. 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.
- E. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 - 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 3. Install insulation to flanges as specified for flange insulation application.
 - 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.08 INSTALLATION OF MINERAL FIBER INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
 - 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 - 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 - 3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
 - 4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
 - 1. Install preformed pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

- 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
- 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install preformed sections of same material as straight segments of pipe insulation when available.
 - 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed sections of same material as straight segments of pipe insulation when available.
 - 2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 - 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 4. Install insulation to flanges as specified for flange insulation application.

3.09 FIELD APPLIED ACKET INSTALLATION

- A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.10 FINISHES

- A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09.
- B. Flexible Elastomeric Thermal Insulation, Exterior Unjacketed: 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.

3.11 FIELD QUALITY CONTROL

- A. Testing: The Owner reserves the right to perform tests and inspections of selected insulation sites.
- B. Tests will include removing field-applied jacket and insulation in layers in reverse order of their installation for each piping system scheduled. If testing reveals defective work, all similar insulation sites will be considered defective, and Contractor will be responsible for cost of inspection and repair.

3.12 PIPING INSULATION THICKNESS

- A. General
 - 1. For piping smaller than 1-1/2 inches and located in partitions within conditioned spaces, reduction of thickness by 1-inch permitted to a thickness not less than 1-inch.
- B. Insulation installed overheat trace for freeze protection: 1-inch thickness
- C. Serviceable components, connections, and couplings.
 - 1. Install Pre-manufactured Removable Insulation Systems at the following:
 - a. Valves, manual and automatic.
 - b. Flanges and unions requiring access to allow equipment service.

- c. Mechanical couplings requiring access to allow equipment service.
- D. Cellular Glass Insulation
 - 1.

CELLULAR GLASS					
FLUID NORMAL OPERATING TEMPERATURE (°F)	NOMINAL PIPE OR TUBE SIZE (inches)				
		1 to	1.5 to	4 to	
	1	1.5	4	8	8
350	6	6	6	6	6
251-350	5	5	5	5	5
201-250	3	3	3	3	3
141-200	2	2	2	2	2
105-140	1	1	1.5	1.5	1.5
0-60	0.5	0.5	1	1	1
40	0.5	1	1	1	1.5

- E. Flexible Elastomeric Insulation
 - 1.

FLE IBLE ELASTOMERIC					
FLUID NORMAL	NOMINAL PIPE OR TUBE SIZE				
OPERATING	(inches)				
TEMPERATURE (°F)	•				
		1 to	1.5 to	4 to	
	1	1.5	4	8	8
350	-	-	-	-	-
251-350	-	-	-	-	-
201-250	2.5	2.5	2.5	3	3
141-200	1.5	1.5	2	2	2
105-140	1	1	1.5	1.5	1.5
40-60	0.5	0.5	1	1	1
40	0.5	1	1	1	1.5

- F. Mineral Fiber Insulation
 - 1.

FIBERGLASS					
FLUID NORMAL OPERATING TEMPERATURE (°F)	NOMINAL PIPE OR TUBE SIZE (inches)				
		1 to	1.5 to	4 to	
	1	1.5	4	8	8
350	5	5	5	5	5
251-350	3.5	4.5	4.5	4.5	4.5
201-250	2.5	2.5	2.5	3	3
141-200	1.5	1.5	2	2	2
105-140	1	1	1.5	1.5	1.5
40-60	0.5	0.5	1	1	1
40	0.5	1	1	1	1.5

3.13 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. For all systems with an operating temperature that may be below ambient conditions, a vapor barrier must be maintained.
- C. For piping smaller than 1-1/2 inches and located in partitions within conditioned spaces, reduction of thickness by 1-inch is permitted to a thickness not less than 1-inch.
- D. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.14 INDOOR PIPING INSULATION SCHEDULE

- A. Piping, Subject to Damage: Piping located within 4-feet of floor level and crossing passageways, or otherwise exposed to physical damage as determined by the Owners Authorized Representative:
 - 1. Calcium Silicate
 - 2. Cellular Glass
- B. Heating-Hot-Water Supply and Return: Normal operating temperature range 140°F to 100°F:
 1. Mineral Fiber
- C. Chilled Water: Normal operating temperature range 42°F to 62°F:
 1. Flexible Elastomeric
- D. Condensate: Normal operating temperature range 42°F to 62°F:
 - 1. Flexible Elastomeric
- E. Chilled Beam Water: Normal operating temperature range 52°F to 62°F:
 1. Elastomeric Foam
- F. Refrigerant Suction and Hot-Gas Piping, Operating temperature 40-120°F:
 1. Flexible Elastomeric

3.15 OUTDOOR PIPING INSULATION

- A. Chilled Water, Normal operating temperature range 42 °F to 62°F:
 - 1. Cellular Glass
- B. Refrigerant Suction and Hot-Gas Piping, Operating temperature 42-120°F:
 1. Flexible Elastomeric
- C. Heat traced piping including condenser water supply and return, non-potable make-up water, and drain piping. Normal operating temperature range 40°F to 95°F:
 - 1. Flexible Elastomeric

3.16 INDOOR, FIELD APPLIED ACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the fieldapplied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Subject to Damage: Piping located in mechanical rooms within 6-feet of floor level, across passageways, or otherwise exposed to physical damage as determined by the Owners Authorized Representative:
 - 1. PVC: 30 mils thick.

3.17 OUTDOOR, FIELD APPLIED ACKET SCHEDULE

- A. Provide jacketing for all outdoor insulated piping.
- B. Install jacket over insulation material. For insulation with factory-applied jacket, install the fieldapplied jacket over the factory-applied jacket.
- C. If more than one material is listed, selection from materials listed is Contractor's option.
- D. Piping, Concealed:
 - None. 1.
- E. Piping, Exposed:1. Painted Aluminum, Smooth: 0.016 inch thick.

END OF SECTION

SECTION 23 0800

COMMISSIONING OF HVAC

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes Commissioning activities required for work of Division 23 Sections including but not limited to construction checks, equipment start-up, functional testing, and operator training.
 - 1. Comply with Section 01 91 13 General Commissioning Requirements for Commissioning activities for Division 23 work.

1.02 SEQUENCING

- A. Provide written notification to Commissioning Provider (CxP) in advance of significant project dates as directed and as listed below.
 - 1. Two weeks prior to start-up of air handling units, air-conditioning units, exhaust fans, boilers and pumps
 - 2. Four weeks prior to installation of lay-in ceiling tiles or other partial concealment of equipment to be commissioned
 - 3. Four weeks prior to any system ready for balancing

1.03 SUBMITTALS

- A. Provide control system custom software, hardware, and technical manuals as necessary for development of Commissioning activities. Control system submittals include but are not limited to operating sequences, point database, workstation remote access, on-site custom programming/editing software, and programming and operations manual as necessary for development of Commissioning activities. Submit a minimum of 12 weeks prior to equipment start-up.
- B. Provide sample control verification report to Commissioning Provider 12 weeks prior to substantial completion. Submittal shall show format and content of Final Verification Report.
- C. Provide submittals of systems being commissioned to Owner's Authorized Representative as required by Section 01 91 13.
- D. Provide electronic copies (or hard copies where appropriate) of control system final configuration parameters, programs, databases, files, and electrical data as necessary to reconfigure and/or replace control components upon device failure.
- E. Contractor to provide electronic copies of work products and other items as specified to support development of commissioning documentation. Refer to Section 01 91 13 for specific submittal requirements.
- F. Testing, Adjusting, and Balancing (TAB) Pre-balancing Submittal: Provide electronic submittal directly following approval of the HVAC control submittal. The TAB pre-submittal shall include the following:
 - 1. Preliminary TAB report including report documentation forms with design data and existing equipment data listed.
 - 2. Review Contract Documents and provide list of provisions that are not included but necessary to complete work such as balancing dampers, valves, flow measuring stations, test plugs, access doors, etc.
 - a. Provide a description of any conditions that are unclear, contradictory, or otherwise may prevent the specified system from achieving design performance.
 - 3. Summary of BAS system calibration measurements and tests required to establish setpoint or control parameters such as duct static pressure setpoints, airflow and/or fan speed offsets, pump differential pressure etc.
 - 4. Summary of minimum outside air ventilation measurements, adjustments, and control devices required to establish specified control sequences (i.e., damper positions, fan speeds, airflow station etc.)

PART 2 PRODUCTS

2.01 MATERIALS

- A. Provide all necessary control hardware, software, and temporary licenses to enable Commissioning Provider to conduct activities and to fully access any electronic control systems furnished for this project. Commissioning Provider's laptop computer may be used for access if software and hardware systems provided are compatible with existing computer configuration, otherwise furnish laptop computer where required for duration of project.
- B. Provide minimum of two HVAC control operator interface sites for both on-site and remote access as described below:
 - 1. Commissioning Provider Access Functions: Review and modification of control programming, monitoring of control system operations, review and modification of software database, setup, and monitoring trend data in tabular and graphical formats.
 - 2. Remote Access: Remote access using Internet and shall include all functions described above.
 - 3. Provide credentials for Commissioning Provider. Security access level shall be suitable to perform necessary commissioning functions.
 - 4. Provide labor required to install hardware and software on personal computers at Commissioning Provider's office. Software will be manufacturer's most recent version and will be compatible with the CxP's personal computers. Provide Commissioning Provider with two hours training after fully functional remote access is established.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Manufacturer's Representative to execute Construction Checklists and perform operational training as specified in Division 23 including the following systems:
 - 1. Boilers
 - 2. Chiller
 - 3. Variable frequency drives
 - 4. Building Automation System

3.02 CONTROL VERIFICATION REPORTS

- A. Building Automation System: BAS control contractor shall perform verification of the function and performance of control hardware and software. Provide verification report demonstrating proper system installation and operation. Verification report shall include the following:
 - 1. Network Communication: Verify that all network devices properly communicate on network. Verify communication speed and reliability is acceptable.
 - 2. Input and Output Verification:
 - a. Verify that all input and output points are indicating properly. Verification tests shall be "end-to-end," meaning field measurement to workstation graphic display value.
 - b. Calibrate all analog inputs. Acceptance accuracy shall be as specified for product accuracy. Repair or replace all devices that do not conform to specified accuracy.
 - c. Operate all analog outputs from 0% to 100% of operating range. Verify that controlled device operates over the entire output range and that maximum and minimum operating conditions are achieved.
 - d. Valves and dampers shall close fully and provide tight shutoff. Leakage rates shall not exceed specified values.
 - e. Verify that all digital outputs operate controlled devices.
 - 3. Sequence of Operation Verification: Systematically verify automatic control sequence of operation functions in field after installation is complete. Verification shall include:
 - a. Time scheduling.
 - b. Operating modes.
 - c. Tune and adjust control loops and control sequences to optimize efficiency and performance. Control loops shall be stable and maintain desired setpoints.

- 4. Trending: Confirm trending utilities storage of operating data as required to verify operation and performance of control modes, sequence, and loops. Meet with Owner and CxP to review configuration, parameter interval, and duration prior to trend setup.
- 5. Operator Interface: Review function of operator interface. Confirm that graphic operator interface accurately depicts as-constructed system configuration and that all required content is displayed and functions as intended.
- 6. Alarms: Confirm alarm utilities are configured as required, alarm conditions are displaying in alarm logs and on graphic displays, and provide annunciation and reporting as required. Meet with Owner and CxP to review configuration parameters prior to alarm utility setup.
- 7. Coordination: Assist balancing contractor with development of control setpoints and parameters as specifically indicated or otherwise required to provide Sequence of Operation. Setpoints would include but would not be limited to actuator positions required to provide minimum ventilation rates, supply air pressure setpoints for variable air volume air distribution systems, and terminal unit calibration parameters.
- 8. Controls Verification Report: After system operation is completely verified, provide written certification to Owner that systems have been fully tested, are operating according to specifications, and ready for functional testing. Include documentation to the Commissioning Provider detailing verification results. Report shall include:
 - a. Updated control construction drawings and equipment data that incorporates all changes made during construction.
 - b. Printed as-built control code.
 - c. Printed point data base.
 - d. Input/Output Verification Log: Submit point verification log including point identification, control system readout value, verification measurement, and required calibration offset where applied.
 - e. Sequence of Operation Verification: Submit verification test report listing complete text of control sequence and test results. Verify all specified control sequences.
 - f. Trend Logs: Submit printed trend reports for the following:
 - 1) Time schedules. Seven-day log demonstrating that equipment operates according to programmed time schedules.
 - 2) Automatic control sequences. Trends shall be set-up as follows:
 - a) Analog Control: Points that modulate over time shall be sampled at appropriate intervals and durations to demonstrate proper operating sequences. For example, a discharge temperature control loop would require trending during the morning warm-up mode and normal daytime operation mode. Each trend shall include all measured variables, control output signal, actual output signal, and controlled variable.
 - b) Digital Control: Dual-state control or monitoring points shall be recorded as COV () or change of value meaning that the changed parameter only needs to be recorded after the value changes from its previous state. A minimum of one week of samples shall be provided to properly demonstrate equipment cycles, modes, and schedules.
 - g. Include trend graphs as described below:
 - 3) Lines shall be labeled and shall be distinguishable from each other by using either different line types, or different line colors.
 - 4) Indicate engineering units of the y-axis values; e.g., degrees F., inches w.g., Btu/lb, percent wide open, etc.
 - 5) The y-axis scale shall be chosen so that all trended values are in a readable range. Do not mix trended values on one graph if their unit ranges are incompatible.
 - 6) All points trended for one HVAC subsystem; e.g., air handling unit, chilled water system, etc. shall be trended during the same trend period.
 - 7) Each graph shall be clearly labeled with HVAC subsystem title, date, and times.
 - h. List of incomplete work.

- 9. Demonstration: Demonstrate operation of control system to Engineer, Commissioning Provider, and Owner including:
 - a. Menu functions.
 - b. Point overrides.
 - c. Control loop response after point modification.
 - d. Alarm response time.

3.03 FUNCTIONAL TESTING

- A. Contractor shall assist Commissioning Provider with functional testing as required by Section 01 91 13. Functional Test Plans for each system being commissioned will be prepared by Commissioning Provider during construction and will generally include a rigorous verification of instrument calibration, equipment performance, packaged equipment control system operations, automatic control sequence of operations, fire and life safety sequences, and operator interface functions. Commissioning Provider will supervise and document functional testing. Contractor shall provide qualified technicians to assist Commissioning Provider during on-site testing and perform the following functions.
 - 1. Operate equipment and systems as necessary to conduct testing.
 - 2. Manipulate control parameters to simulate test conditions as detailed in Functional Test Plans.
 - 3. Access control programming and database as required to verify control configuration or to correct observed deficiencies.
 - 4. Create graphic displays and/or trend report as required to document test results.
 - 5. Provide proprietary hardware and software as needed to interface with manufacturer's packaged control systems.
- B. Labor required for retesting due to failure of equipment, or systems not performing in accordance with Contract Documents shall be provided at no additional cost to Owner.

3.04 SCHEDULE OF SYSTEMS BEING COMMISSIONED

- A. Commission systems and equipment listed below, including associated equipment, piping, ductwork, and control systems.
- B. HVAC Systems: All HVAC systems, equipment, and controls

END OF SECTION

SECTION 23 0923

BUILDING AUTOMATION SYSTEMS FOR HVAC

PART 1 GENERAL

1.01 SUMMARY

- A. Work hereunder includes a complete and operational, fully tested, distributed logic, building automation system (BAS) for control of systems and equipment specified in Divisions 22 and 23. Associated work includes but is not limited to:
 - 1. A network of stand-alone, microprocessor-based building controllers, advanced application controllers, and application specific controllers.
 - 2. Communication, control wiring, power circuits, power supplies, and power wiring as required.
 - 3. Building operation and energy management software and related programming including complete licensing agreement for complete use and access of software required for installation, configuration, programming, and operation.
 - 4. Field Mounted Devices as specified in Section 23 09 25 BAS Field Mounted Devices for HVAC.
 - 5. Control sequences as specified in Section 23 09 29 BAS Sequence of Operations for HVAC.
 - 6. Other materials and devices not shown as part of other work but necessary to provide mechanical and electrical system control and monitoring sequences specified.

1.02 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Control Contractor to coordinate with other trades to ensure delivery and correct installation of products furnished but not installed under this section. Coordination to include a review of schedule, manufacturer's installation requirements, and equipment locations. Such products include but are not limited to the following:
 - 1. Dampers
 - 2. Control Valves
 - 3. Actuators
 - 4. Terminal Unit Controllers

1.03 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Control Contractor to coordinate with other trades to ensure correct installation and control of products installed but not furnished under this section. Such products include but are not limited to the following:
 - 1. Thermostats furnished with packaged equipment

1.04 RELATED SECTIONS

- A. Section 23 09 25 BAS Field Mounted Devices for HVAC
- B. Section 23 09 29 BAS Sequence of Operations for HVAC

1.05 SUBMITTALS

- A. Provide submittals for products listed in the Product Table below in accordance with Section 23 05 00 – General HVAC Provisions. Submittal requirements indicated by column number designation as follows:
 - 1. Materials List
 - 2. Catalog Data
 - 3. Product Data
 - 4. Performance Data
 - 5. Wiring Diagrams
 - 6. Shop Drawings
 - 7. Installation Instructions

8. Special Requirements listed herein.

PRODUCT TABLE	1	2	3	4	5	6	7	8
All Products This Section								

- B. Special Requirements:
 - 1. Provide all control submittals including Sections 23 09 23 Building Automation Systems for HVAC, 23 09 25 BAS Field Mounted Devices for HVAC, and 23 09 29 BAS Sequence of Operations for HVAC as a single package.
 - 2. Submittals prior to starting work:
 - a. Submit in accordance with Division 01 and Section 23 05 00 General HVAC Provisions within 6 weeks of project award.
 - b. All required schematics and plans prepared on AutoCAD release 12 or higher.
 - c. When manufacturers' product information applies to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the pertinent specification or drawing.
 - d. Building Automation System Hardware:
 - Provide a complete bill of materials of building automation control system hardware indicating quantity, manufacturer, model number, and technical data. Technical data shall include performance curves, product specifications sheets, and installation/maintenance instructions.
 - 2) Network Communication Diagrams: Provide schematic diagram showing all BAS panels, communications cabling, and termination points. Identify power requirements and power source for each BAS panel. Identify equipment each BAS panel is controlling. Show termination numbers.
 - 3) Provide plans indicating locations of all BAS hardware.
 - 4) Provide panel interior and exterior layout details for prefabricated control panels. Details shall include equipment layout and routing of wiring.
 - 5) Provide two copies of programming manuals for each BAS controller furnished.
 - 6) Provide a listing and description of all available training programs. Indicate a cost for each location that the training program is available.
 - e. Central System Hardware and Software:
 - Provide a complete bill of materials of central system hardware and software indicating quantity, manufacturer, model number, and technical data. Technical data shall include product specification sheets and installation/maintenance instructions. Data shall be provided for all equipment including but not limited to the following:
 - a) Central processing unit
 - b) Monitors
 - c) Printers
 - d) Keyboard
 - e) Power supply
 - f) Battery backup
 - g) Interface equipment between central processing unit and direct digital control panels.
 - h) Operating system software
 - i) Operator interface software
 - j) Color graphic software
 - k) Third-party software
 - 2) Provide schematic diagram of the central system including all control, communication, and power wiring. Label all cables and ports with computer manufacturers' model numbers and functions.
 - 3) Provide a list of color graphics screens to be provided. Indicate each screen content and relation to other screens.

- f. Controlled Systems:
 - 1) Provide an instrumentation list for each controlled system including all controlled system elements in table format. Tables to show element name, type of device, manufacturer, model number, and product data sheet number.
 - Provide a schematic diagram of each controlled system. Include control points labeled with appropriate point names. Graphically show the location of all control elements.
 - 3) Provide a schematic wiring diagram for each controlled system. Label all elements. Label all terminals.
 - 4) Provide a mounting, wiring, and routing plan-view drawing. Layout to account for HVAC, electrical, and other system design and layout requirements.
 - 5) Provide a complete description of the function of each controlled system including sequence of operation.
 - 6) Provide a points list for each system controller including both input and output (I/O) points. Note point designations, point function, controlled device associated with the I/O point, location of the I/O device, and point alarm requirements.
- 3. Submittals during construction
 - a. Database information: Four weeks prior to system start-up, provide two copies of complete database information for Engineer's record. Database information will not be reviewed for conformance with Contract Documents. Database information shall include system configuration parameters, point definitions, alarm and trending parameters, control parameters, and control software programs. Specifically document all control functions that cannot be performed by applications specific controllers using pre-programmed control routines or which must be performed by supervisory control from a general-purpose controller.
 - b. Graphics: Provide three copies of all proposed graphics screens for review prior to installation. Allow 2 weeks for review.
 - c. Contractor Verification: Provide Contractor checkout and testing documentation.
- 4. Closeout Submittals
 - a. Submit in accordance with Division 01. Submit 14 days prior to final completion for approval.
 - b. Record documents shall include the following:
 - Project record drawings. Project record drawings will be as-built versions of the shop drawings. Include one set of magnetic media including CAD drawings in .DWG format.
 - 2) Provide copy of testing and commissioning reports. Include trend logs used for verification.
 - 3) Material to be included in Project Operation and Maintenance Manuals
 - a) Names, addresses and 24-hour telephone numbers of installing Contractors and the service representatives for each.
 - b) Operator's manual with procedures for operating the control systems including logging on/off, alarm handling, producing point reports, trending data, overriding computer control, and changing set points and other variables.
 - c) A listing and documentation of all custom software created using the programming language including set points, tuning parameters, and object database.
 - d) A list of recommended spare parts with part numbers and suppliers.
 - e) Recommended preventive maintenance procedures for all system components including a schedule of tasks, time between tasks, and task descriptions.
 - 4) Supplemental Record Information
 - a) Two sets of programming manuals with a description of the programming language (including syntax), statement descriptions (including algorithms and calculations used), point database creation and modification, and use of the program editor.

- b) Two sets of engineering, installation, and maintenance manuals explaining how to design and install new points, panels, and other hardware; preventive maintenance procedures; how to debug hardware problems; and how to replace or repair hardware.
- c) One set of magnetic/optical media containing backup files of the software and database.
- d) One set of magnetic/optical media containing files of all color graphic screens created for the project.
- e) One set of complete original issue documentation for third-party software including installation and maintenance instructions.
- f) One set of complete original issue diskettes for all operating systems, programming language, operator workstation software, and graphics software.
- g) One set of licenses, guarantees, and warranty documents for all system equipment.

1.06 DESIGN REQUIREMENTS

- A. BACnet Compliance
 - 1. The BAS shall exchange data between workstations or workstations and building level controllers over the Management Level Network and First-tier BAS Controller Level Network using BACnet Protocol in the form of BACnet objects.
 - 2. The BAS shall perform network functions using the following BACnet services:
 - a. Alarm and Event
 - b. Scheduling
 - c. Trending
 - d. Network Management
- B. Performance Standards:
 - 1. Graphic Display: System shall display a graphic with 20 dynamic points and all current data within 10 seconds.
 - 2. Graphic Refresh: System shall update a graphic with 20 dynamic points and all current data at no greater than 8 second intervals.
 - 3. Object Command: The maximum time between an operator command of a binary object and the reaction of the commanded device shall be 2 seconds. The maximum time between an operator command of an analog object and the start of object adjustment shall be 2 seconds.
 - 4. Object Scan: All changes of state and change of analog values will be transmitted on system communications networks such that any data used or displayed at a controller will have been current within the previous 6 seconds.
 - 5. Alarm Response Time: The maximum time from an object going into alarm-to-alarm annunciation at the workstation shall not exceed 45 seconds.
 - 6. Program Execution Frequency: Custom and standard applications shall be capable of running as often as once every 5 seconds. Contractor shall select execution times consistent with the process under control.
 - 7. Performance: Programmable controllers shall be able to execute BAS PID control loops at a selectable frequency of a least once per second. The controller shall scan and update the process value and output generated at the same frequency.
 - 8. Multiple Alarm Annunciations: All workstations on the network must receive alarms within 5 seconds of each other.
 - 9. Reporting Accuracy: The system shall report all values with an end-to-end accuracy no less than listed in Table 1.
 - 10. Stability of Control: Control loops shall maintain measured variable at setpoint within tolerances listed in Table 2.

11.

TABLE 1 - REPORTING ACCURA	AC						
Measured Variable	Reported Accuracy						
Space Temperature	_1°F						
Ducted Air	_1°F						
Outside Air	_2°F						
Dew Point	3°F						
Water Temperature							
Delta-T	0.25°F						
Relative Humidity							
Water Flow	5% of full scale						
Airflow (terminal)	_10% of full scale (see Note 1)						
Airflow (measuring stations)	_5% of full scale						
Airflow (pressurized spaces)	3% of full scale						
Air Pressure (ducts)	0.1 in. w.g.						
Air Pressure (space)	_0.01 in. w.g.						
Water Pressure	_2% of full scale (see Note 2)						
Electrical (A, V, W, Power	5% of reading (see Note 3)						
Factor)							
Carbon Monoxide (CO)	_5% of reading						
Carbon Dioxide (CO ₂)	_50 ppm						
Note 1: 10%-100% of scale							
Note 2: For both absolute and differential pressure							
Note 3: Not including utility-suppli	Note 3: Not including utility-supplied meters						
TABLE 2 - CONTROL STABILIT	AND ACCURAC						
Controlled Variable	Control	Range of Medium					
	Accuracy						
Air Pressure	_0.01 in. w.g.	0-6 in. w.g.					
Airflow	_10% of full	-0.1 to 0.1 in. w.g.					
	scale						
Space Temperature	_2.0°F						
Duct Temperature	_3.0°F						
Humidity	_5% RH						
Fluid Pressure	_1.5 psi	1-150 psi					
	10 in wa	0-50 in w a differential					

1.07 QUALITY ASSURANCE

- A. All products required to conform to BACnet Standards must be BACnet Testing Laboratory (BTL) listed.
- B. All products used in this application, except for those specifically indicated for reuse, shall be new and under current manufacture and shall be the most recent version offered by the manufacturer for the application. Spare parts shall be available from the manufacturer for at least five years after final completion.
- C. Control Contractor to have in-house, factory-trained and factory-authorized installers and programmers.

1.08 CODES AND STANDARDS

- A. Work, materials, and equipment shall comply with all local, state, and federal codes and ordinances.
- B. Each DDCP shall be listed under UL916 (Energy Management Systems), UL864-UDTZ (Signal Systems Unit) and shall be tested to comply with sub-part J of Part 15 FCC rules for Class A computing equipment.

1.09 UPDATES

A. Provide at no extra cost all software and firmware updates that become available from the manufacturer during the warranty period.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Reliable, Allerton, or approved.

2.02 COMMUNICATIONS

- A. Architecture: Network architecture shall consist of three levels: a management level network, a first-tier controller level, and a second-tier controller level. As an alternative, the management level and first-tier controller levels may be combined into a single level.
 - 1. Management Level Network:
 - a. The Management Level Network will be used for communications between workstations or workstations and building level controllers.
 - b. The Management Level Network shall reside on industry standard Ethernet physical link using BACnet communications protocol.
 - c. The Management Level Network shall operate at a minimum of 2.5 M baud with full peer-to-peer network communication.
 - 2. First-tier BAS Controller Level Network:
 - a. The first-tier controller level will be used for communications between Building Controllers or Building Controllers and Advanced Application Controllers.
 - b. The first-tier BAS controller level shall reside on industry standard Ethernet physical link using BACnet communications protocol.
 - c. The first-tier BAS controller level shall operate at a minimum of 2.5 M baud with full peer-to-peer network communication.
 - 3. Second-tier BAS Controller Level Network:
 - a. The second-tier BAS controller level will be used for communications between Building Level Controllers, Advanced Application Controllers and Application Specific Controllers.
 - b. The second-tier BAS controller level shall be performed using peer-to-peer or MS/TP, LonWorks, or other proprietary communications protocols.
 - c. Second-tier communications shall operate at a minimum speed of 9600 baud.
- B. Contractor shall provide all communication media, connectors, repeaters, hubs, and routers necessary for network communications.
- C. Communications shall provide operator interface and value passing that is transparent to the system architecture as follows:
 - 1. Connection of an operator interface to any controller on the system will allow the operator to interface with all other controllers as if that controller were directly connected. Data, status information, reports, system software, custom programs, etc., for all controllers shall be available for viewing and editing from any controller on the system.
- D. All database values (e.g., objects, software variables, custom programming variables) of any controller shall be readable by any other controller on the system. Value passing shall be automatically performed by a controller when a reference to an object name not located in that controller is entered into the controller's database. An operator/installer shall not be required to set up any communication services to perform system value passing.
- E. The network shall have the following minimum capacity:
 - 1. The first-tier network shall support 50 first-tier controllers.
 - 2. Each first-tier controller shall support 50 second-tier controllers.
 - 3. The entire system shall have the capacity for 12,500 input/output objects associated with first-tier controllers, advanced application controllers, or application specific controllers.

2.03 WORKSTATION GRAPHICS

- A. System Graphics: Provide graphic oriented operator workstation software. System shall display up to 10 graphic screens at once for comparison and monitoring of system status. Provide a method for operator to easily move between graphic displays and change the size and location of graphic displays on the screen. System graphics modifiable while online including addition, deletion, or changes to objects on a graphic screen. Dynamic objects shall include analog and binary values, dynamic text, static text, and animation files. Graphics shall show animation by shifting image files based on object status.
- B. Custom graphic files created by using graphics generator package furnished hereunder. Graphics package shall use mouse to create and modify graphics that are saved in industry standard formats such as PC , TIFF, and GEM. The graphics package shall also function to capture or convert graphics from other programs such as Designer or AutoCAD.
- C. Graphics Library: Furnish a complete library of standard HVAC equipment graphics including chillers, boilers, air handlers, terminal units, fan coils, unit ventilators, etc. Library to also include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. Library provided in file format directly compatible with graphics package.

2.04 SYSTEM APPLICATION SOFTWARE

- A. General: System applications are edited and archived on the PC workstation but executed on the appropriate building controller.
- B. Automatic System Database Save and Restore: Each workstation shall store on the hard drive a copy of the current database of each controller. The database shall update whenever a change is made in any system panel. Storage of the database shall be automatic and not require operator intervention. The first workstation to detect a database loss, shall automatically restore the database for that controller. Automatic restoration may be disabled by the operator.
- C. Manual Database Save and Restore: Authorized operators able to save the database from any system panel. Operator able to clear a panel database and manually initialize a download of a specified database to any panel on the system.
- D. System Configuration: Workstation software shall provide a method to configure the system to allow for future system changes or additions.
- E. Online Help: Provide a context-sensitive, on-line help system. On-line help available for all applications and shall provide data relevant to screen displayed. Additional help available through use of hypertext.
- F. Security: Each operator shall be required to log on to the system with a username and password to view, edit, add, or delete data whether accessing system from the workstation, portable operator's terminal, or proprietary portable terminal. System security selectable for each operator. System supervisor shall set passwords and security levels for all other operators. Each operator password shall restrict viewing and changing of each system application, editor, and object. Each operator automatically logged off if keyboard or mouse activity is not detected within a useradjustable time. All security data stored in encrypted form.
- G. System Diagnostics: System shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. Failure of any device shall be annunciated at the workstation.
- H. Alarm Processing: Any object in the system configurable to alarm in and out of normal state. Operator able to configure alarm limits, alarm limit differentials, states, and reactions for each object in the system.
- I. Alarm Messages: Alarm messages shall use English language descriptors allowing the operator to recognize the source, location, and nature of the alarm without relying upon acronyms or other mnemonics.
- J. Alarm Reactions: Operator able to set actions to be taken for each alarm. Actions may include logging, printing, starting programs, displaying messages, dialing out to remote stations, paging,

providing audible annunciation, or displaying specific system graphics. Each action configurable by workstation and time of day.

- K. Trend Logs: Operator able to define a custom trend log for any data object in the system. Trend definition shall include interval, start time, and stop time. Trend interval shall be selectable as fixed time or change in value. Trend data sampled and stored on the building controller panel, archived on the workstation hard drive, and retrievable for use in spreadsheets and database programs. System shall be capable of storing 500 sample for each data point.
- L. Alarm and Event Log: Provide chronological alarm and event log. Authorized operator able to view alarm and event log from any location in the system and acknowledge and clear alarms. All alarms that have not been cleared shall be archived to the hard drive on the workstation.
- M. Object and Property Status and Control: Operator able to view and, if required, edit the status of any object and property in the system.
- N. Time clocks in all controllers shall be automatically synchronized daily. An operator change to the time clock in any controller shall be automatically broadcast to all controllers on the system. System shall automatically adjust for daylight savings and standard time.
- O. Reports and Logs: Provide a reporting package allowing the operator to select, modify, or create reports. Each report definable for data content, format, interval, and date. Report data archivable on the workstation hard drive for historical reporting. System capable of supplying real-time logs of all objects by type or status (e.g., alarm, lockout, normal). Reports and logs shall be stored on the workstation hard drive in a format readily accessible to other standard software applications, including spreadsheets and word processing. Reports and logs readily sent to the system printer by either operator command or automatically by time-of-day. Standard reports shall include:
 - 1. Objects: All system objects and their current value.
 - 2. Alarm Summary: All current alarms (except alarms in lockout).
 - 3. Disable Objects: All objects that are disabled.
 - 4. Alarm Lockout Objects: All objects in manual or automatic alarm lockout.
 - 5. Alarm Lockout Objects in Alarm: All objects in alarm lockout that are currently in alarm.
 - 6. Logs including alarm history, system messages, system events, trends.
- P. Remote Communication: Provide the capability to dial out in the event of an alarm.
- Q. Standard Application Programs:
 - 1. Sequencing: Provide application software to sequence equipment as required by Section 23 09 29 BAS Sequence of Operations for HVAC.
 - PID Control: Provide a proportional-integral-derivative (PID) algorithm with direct or reverse action and anti-windup to perform modulating control of building equipment as required by Section 23 09 29 – BAS Sequence of Operations for HVAC. Algorithm shall calculate a time-varying analog value to position an output or stage a series of outputs. User-selectable controlled variable, setpoint, and PID gains.
 - 3. Staggered Start: Provide staggered-start application to prevent all controlled equipment from simultaneously restarting after a power outage. User selectable order-of-equipment restart and time delay between starts.
 - 4. Energy Calculations:
 - a. Provide application to allow instantaneous power or flow rates to be accumulated and converted to energy use data.
 - b. Provide application to calculate a sliding-window average. User selectable window intervals.
 - c. Provide application to calculate a fixed-window average. Initiation of window from digital input signal. User selectable window intervals.
 - 5. Anti-short Cycling: Provide application to prevent any binary output from short cycling. User selectable minimum on-time and off-time.
 - 6. On/off Control with Differential: Provide application allowing a binary output to be cycled based on a controlled variable and setpoint. User selectable direct or reverse action and differential setpoint.
 - 7. Run-time Totalization: Provide application to totalize run-times for all binary input objects.

8. Time Control Scheduling: Provide application that will start and stop digital and software points according to an adjustable time schedule. Application shall include for basic time schedule, optimum start/stop, special event override, and holiday override.

2.05 WORKSTATION APPLICATION EDITORS

- A. General: Provide Workstation Application Editors to edit all applications that reside at system controllers. Applications shall be downloaded and executed at one or more of the controller panels.
- B. Controllers: Provide a full-screen editor for each type of application allowing the operator to view and change the configuration, name, control parameters, and setpoints for all controllers.
- C. Scheduling: Provide an editor for the scheduling application. Provide a monthly and weekly calendar for each schedule where scheduling parameters can be changed. Provide a method allowing several objects to follow a schedule with start and stop times for each object adjustable from a master schedule. Schedules shall be easy to copy to other objects and dates.
- D. Custom Application Programming: Provide the tools to create, modify, and debug custom application programming. Program creation, modification, or downloading allowed while all other system applications are operating. The programming language shall provide the following features:
 - 1. Provide English language orientation based on BASIC, FORTRAN, C, or PASCAL. Language shall allow free-form programming, i.e., not column-oriented or "fill in the blanks". Alternately, the programming language can be graphically based using function blocks if blocks are available to directly provide the functions listed below and custom or compound function blocks can be created.
 - 2. Provide a full-screen character editor. Editor shall be curser/mouse-driven allowing the user to insert, add, modify, and delete custom programming code. Editor shall also support word processing features such as cut/paste and find/replace.
 - 3. Allow development of independently executing program modules with each module able to independently enable or disable other modules.
 - 4. Provide debugging/simulation capability allowing users to step through the program and observe intermediate values and results. Debugger shall provide error messages for syntax and execution errors.
 - 5. Support conditional statements (IF/THEN/ELSE/ELSE-IF) and relations comparisons (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL).
 - 6. Support floating-point arithmetic using operators including plus, minus, divide, times, and square root. The language shall also provide absolute value and minimum/maximum value from a list of values.
 - 7. Provide pre-defined variables representing time of day, day of the week, month of the year, and date. Provide additional variables including elapsed time in seconds, minutes, hours, and days. Elapsed time variable may be reset so that interval-timing functions can be stopped and started within a program. Values from above variables readable so that they can be used in a program for IF/THEN comparisons, calculations, etc.
 - 8. Programming language shall have pre-defined variables representing the status and results of Controller Software and shall be able to enable, disable, and change the setpoints of Controller Software.

2.06 SYSTEM CONTROLLERS

- A. First-tier Controllers (Building Controllers): Independent, stand-alone, microprocessor-based controller to manage global control and communication. Provide the number of first-tier controllers needed to meet specified performance requirements. As a minimum, provide one first-tier controller per building. Controllers shall have the following general characteristics. BTL Listed.
 - 1. Sufficient memory in each controller to support its operating system, database, and programming requirements including specified spare capacity.

- 2. Controller operating system to manage input and output communications allowing distributed controllers to share real and virtual object information and allow central monitoring and alarms.
- 3. Controller shall continually check the status of its processor and memory circuits. If an abnormal condition is detected, the controller shall assume a pre-determined failure mode, and generate an alarm notification.
- 4. Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
- 5. Controller shall include a service communication port allowing connection to a portable operator's terminal.
- B. Advanced Application Controllers: Independent, stand-alone, microprocessor-based controller to provide local control of systems and equipment requiring advanced program sequences. Provide the number of advanced application controllers needed to meet specified performance requirements. Controllers shall have the following general characteristics. BTL Listed.
 - 1. Sufficient memory in each controller to support its operating system, database, and programming requirements including specified spare capacity.
 - 2. Controller operating system to manage input and output communications allowing distributed controllers to share real and virtual object information and allow central monitoring and alarms.
 - 3. Controller shall continually check the status of its processor and memory circuits. If an abnormal condition is detected, the controller shall assume a pre-determined failure mode, and generate an alarm notification.
 - 4. Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
 - 5. Controller shall include a service communication port allowing connection to a portable operator's terminal.
- C. Application Specific Controllers: Independent, stand-alone microprocessor-based controller to control local equipment or systems where the associated sequence of operation can be met using pre-programmed control routines. Controllers should have the following general characteristics:
 - 1. Sufficient memory in each controller to control the target system.
 - 2. Non-volatile memory to maintain the BIOS and programming information in the event of a power failure.
- D. Controller hardware suitable for the anticipated ambient conditions.
 - 1. Controllers used outdoors or in wet conditions mounted in NEMA _____ waterproof enclosures rated for operation at -40 degrees F to 150 degrees F.
 - 2. Controllers used in conditioned space mounted in dust-proof enclosures and rated for operation at 32 degrees F to 120 degrees F.
- E. Provide diagnostic LEDs for power, communication, and processor. All wiring connections made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
- F. All controllers shall operate at 90% to 110% of nominal voltage and perform an orderly shutdown below 80% nominal voltage. Operation protected against electrical noise at 5 to 120 Hz and from keyed radios up to 5 W at 3 feet.

2.07 INPUT OUTPUT INTERFACE

- A. Hardwire inputs and outputs may connect to the system through a first-tier, advanced application, or application specific controller.
- B. All input and output points protected so that shorting of the point to itself, to another point, or to ground will cause no damage to the controller. All input and output points protected from connected voltage up to 24V of any duration.
- C. Binary Inputs: Binary controller inputs shall provide a wetting current of at least 12 mA and shall be protected against the effects of contact bounce and noise. Binary inputs shall sense "dry contact" closure without external power application required.

- D. Pulse Accumulation Inputs: In addition to standard binary input characteristics, pulse accumulation inputs shall accept up to 10 pulses per second.
- E. Analog Inputs: Analog inputs shall allow the monitoring of low voltage (0 to 10VDC), current (4 to 20 mA), or resistance signals (thermistor or RTD). Analog inputs compatible with commonly available sensing devices.
- F. Binary Outputs: Binary outputs to provide on/off control or a pulsed low-voltage signal for pulsewidth modulation. Provide three-position (on/off/auto) switch for each output along with indicator light. Output selectable for normally open or normally closed operation.
- G. Analog Outputs: Analog outputs to provide a modulating 0 to 10V or 4 to 20 mA signal for control of an end device. Provide two-position (auto/manual) switch, status lights, and manually adjustable potentiometer for each output. Analog output drift less than 0.4% of range per year.
- H. Tri-state Outputs: Provide tri-state outputs (two coordinated binary outputs) for control of threepoint floating type electronic actuators without feedback. Use of three-point actuators limited to terminal unit and unit ventilator control applications. Control algorithms shall send the actuator to one end of its stroke every 24 hours for verification of operator tracking.

2.08 POWER SUPPLIES AND LINE FILTERING

- A. Provide UL listed control transformers. Provide class 2 current-limiting type or furnish overcurrent protection in both primary and secondary circuits in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.
- B. Provide transient voltage and surge suppression for all workstations and controllers either internally or as an external component. Surge suppression shall have the following minimum performance criteria:
 - 1. Dielectric strength of 1000 volts minimum.
 - 2. Response time of 10 nanoseconds.
 - 3. Transverse mode noise attenuation of 65 dB or greater.
 - 4. Common mode noise attenuation of 150 dB or better at 40 Hz to 100 Hz.
- C. Provide UPS where critical functions are performed.
- D. Uninterrupted Power Supplies: Provide uninterrupted power supply (UPS) for all control devices furnished under this project to maintain all control systems fully operational for a period of 24 hours in the event of a power outage. Contractor responsible for sizing UPS to meet power demands of supplied equipment. UPS equipped with a digital alarm output which activates when equipment has malfunctioned or battery failure.

2.09 WEB INTERFACE

- A. General:
 - 1. BAS supplier shall provide web-based access to the system via connection to Owner's Ethernet network connection.
 - 2. Contractor shall provide all communication media, connectors, repeaters, servers, hubs, and routers necessary for network connection.
 - 3. System shall allow simultaneous web interface by up to five independent users without additional licensing or upgrades to hardware or software provided hereunder.
 - 4. User shall not require installation of software on non-workstation computers beyond a current Microsoft or Netscape Navigator browser.
- B. Architecture: System may provide web interface through workstation, independent stand-alone Web host, or building controller.
- C. Capabilities:
 - 1. System graphics: Provide navigation capability through all system graphics. Provide real time data display of all system point values.
 - 2. View trend graphics: Provide trend information via graphical display. User shall be able to select points to be viewed and set time period and display interval.
 - 3. Alarms: Users shall be able to receive, acknowledge, and silence alarms.
 - 4. Event Log: Users shall be able to view event log.

- 5. Scheduling: Users shall be able to view and modify equipment operating schedules.
- D. Security: Access via the Web browser shall use the same hierarchical security scheme as the BAS. User shall be asked to log in once the browser makes connection to the system, and activity will be limited to those allowed by security limits. After log-in, the system shall record all activity on the event log. Systems shall monitor unsuccessful login attempts. If unsuccessful login attempts exceed owner defined setpoint send alarm message to alarm log and turn off WEB server.

2.10 WIRING AND RACEWAYS

- A. Provide wiring, plenum cable, and raceways in accordance with Division 26.
- B. All insulated wire to have copper conductor. UL labeled for 90 degree C service.

PART 3 EXECUTION

3.01 COORDINATION

- A. Testing and Balancing
 - 1. Provide to the Testing and Balancing Contractor a set of all tools and temporary licenses necessary to interface to the control system for testing and balancing purposes. Tools to be returned at the completion of test and balancing work.
 - 2. Provide training in the use of the tools.
 - 3. Provide a qualified technician to assist in the testing and balancing process where required.
- B. Life Safety
 - 1. Hardwire interlock smoke dampers or fire smoke damper to air handler motor starters where dampers are capable of closing off more than 50% of the total fan supply air or return air ductwork area. Stop fans if smoke dampers close.
- C. Coordinate with controls specified in other sections or divisions. Other sections or divisions include controls and control devices to be part of or interfaced with the control system specified in this section. Integration and coordination with these controls shall be as follows:
 - 1. All communications media and equipment required to interface with equipment specified in other sections provided hereunder unless specifically stated otherwise.
 - Each supplier of a control product is responsible for the configuration, programming, startup, and testing of that product to meet the sequence of operation stated in Section 23 09 29 – BAS Sequence of Operations for HVAC.
 - 3. Coordinate and resolve any compatibility issues arising between control products provided hereunder and those provided under other sections or divisions.

3.02 WORKMANSHIP

- A. Install all equipment in accordance with manufacturers' recommendations.
- B. Install equipment, piping, and wiring/raceway parallel to building lines wherever possible.
- C. Provide sufficient slack and flexible connections in wiring to allow for vibration of piping and equipment.
- D. Install all equipment in readily accessible locations as defined by Chapter 1, Article 100, Part A of the National Electric Code.

3.03 GENERAL WIRING

- A. All control and interlock wiring shall comply with national and electrical codes and Division 26. Where requirements of this section differ from those in Division 26, the requirements of this section shall take precedence.
- B. Provide circuits for controls power as required. Coordinate with Division 26 for provision of power.
- C. All line voltage wiring shall be UL listed in approved raceway according to NEC and Division 26 requirements.
- D. All low-voltage wiring shall meet NEC Class or Class 2 requirements. Low voltage power circuits shall be sub-fused when required.

- E. Where NEC Class 1 and Class 2 wires are in concealed and accessible locations, including ceiling plenum return air plenums, approved cable not in raceway may be used provided cables are UL listed for the intended application.
- F. All wiring in mechanical, electrical, or service rooms and wiring located where it may be subject to damage shall be installed in raceway.
- G. Do not install Class 2 wiring in raceways containing Class 1 wiring. Boxes and panels containing high-voltage wiring may not be used for low-voltage wiring except for the purpose of interfacing the two.
- H. Where Class 2 wiring is installed exposed, wiring is to be routed parallel or perpendicular to building lines and neatly tied at a maximum of 10-foot intervals.
- I. Where plenum cables are used without raceway, support or anchor cable from building structure. Do not anchor or support cable from ductwork, electrical raceways, piping, or suspended ceiling systems.
- J. Provide all wire-to-device connections at terminal block or terminal strip. Provide all wire-to-wire connections at terminal block.
- K. Neatly bundle wiring located within enclosures to permit access to devices and terminals.
- L. Maximum allowable voltage for control wiring shall be 120V. If only higher voltages are available, Contractor shall provide a step-down transformer.
- M. All wiring shall be installed as continuous lengths with no splices permitted between termination points.
- N. Install plenum wiring in sleeves where it passes through walls and floors. Provide firestop foam where necessary to maintain fire rating.
- O. Provide size of raceway and size and type of wire as required by NEC and as required to meet manufacturers' recommendations for connected equipment.
- P. Include one pull string in each raceway 1-inch or larger.
- Q. Use color coded conductors throughout.
- R. Locate control and status relays in designated enclosures only. Such enclosures include packaged equipment control cabinets unless such cabinets also contain Class 1 starters.
- S. Conceal all raceways except within mechanical, electrical, or service rooms. Maintain minimum raceway clearance of 6-inches from high temperature equipment such as steam piping or boiler flues.
- T. Secure raceways with raceway clamps fastened to the structure and spaced in accordance with code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be supported from ductwork, electrical raceways, piping, or suspended ceiling systems.
- U. Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of all raceways.
- V. Maintain updated wiring diagrams (as built) at site with terminations identified.
- W. Flexible metal raceways and liquid-tight, flexible metal raceways shall not exceed 3-feet in length and shall be supported at both ends. Flexible metal raceway less than ½-inch electrical trade size shall not be used. In areas exposed to moisture, including but not limited to chiller and boiler rooms, liquid-tight, flexible metal raceways shall be used.

3.04 COMMUNICATION WIRING

- A. Install in accordance with 3.03 above.
- B. Follow manufacturers' recommendations for all communications cabling including but not limited to maximum pulling, tension, and bend radius.
- C. Do not install communications cabling in a raceway or enclosure containing Class 1 or other Class 2 wiring.

- D. Verify the integrity of the entire network immediately following cable installation using test measures appropriate for each cable.
- E. Provide a lightning arrestor between cables and grounds where cable enters or exits a building. Install arrestor in accordance with manufacturers' recommendations.
- F. All communications wiring shall be un-spliced length when that length is commercially available.
- G. All communications wiring shall be labeled to indicate origination and destination.
- H. Ground coaxial cable in accordance with NEC regulations article on "Communications Circuits, Cable and Protector Grounding."

3.05 IDENTIFICATION OF HARDWARE AND WIRING

- A. Label all wiring and cabling, including wiring and cabling terminating within factory-fabricated panels, within 2 inches of termination with the BAS address or termination number.
- B. Permanently label or code each point of field terminal strips to show the instrument or item served.
- C. Identify control panels with minimum ½-inch letters on laminated plastic nameplate.
- D. Identify all other control components with permanent labels. All plug-in components shall be labeled so that removal of component does not remove label.
- E. Identify room sensors relating to terminal box or valves with nameplate located within sensor cover.
- F. Arrange components so that UL or CSA labels are visible after equipment is installed.
- G. Identifiers shall match record documents.
- H. Provide laminated network communication diagrams, point-to-point wiring diagrams, and process control diagrams in each control panel for control components contained therein.

3.06 BAS CONTROLLER INSTALLATION

- A. Provide a separate BAS controller for each air handling unit or other discrete system. A BAS controller may control more than one system provided that all points associated with the system are assigned to the same BAS controller. Points used for control loop reset, such as outside air temperature or space temperature, are exempt from this requirement.
- B. Building Controllers and Advanced Application Controllers shall be selected to provide a minimum of 15% spare I/O point capacity for each point type. If input points are not universal, 15% of each type is required. A minimum of one spare is required for each type of point used.
 - 1. Future use of spare capacity shall require providing the field device, field wiring, point database definition, and custom software. No additional controller boards or point modules shall be required to implement use of spare points.
- C. Provide sufficient internal memory for the specified sequences of operation and trend logging. Provide a minimum of 25% available memory free for future use.

3.07 PROGRAMMING

- A. Provide programming for the system as required to perform the sequence of operation. See Section 23 09 29 – BAS Sequence of Operations for HVAC. Provide all other programming necessary for proper operation of the system but not specified including but not limited to time delays, control deadbands, equipment interlocks, equipment sequencing, alarm notification, and control sequences recommended by equipment manufacturers.
- B. All control setpoints and loop tuning parameters accessible for review and adjustment at workstation graphics or through workstation menus without requiring modification of program code.
- C. For systems using text-based programming, imbed comments in the programming code to clearly describe each section of the program.
- D. Contractor to provide time scheduling functions as specified in the Sequence of Operations. Independent schedules shall be provided for each system, unless otherwise specified.

- E. Contractor to provide alarming functions as specified in the Sequence of Operations. Contractor shall also configure alarming functions as directed by Owner including setting alarm limits and differentials, states, type of notification, and alarm messages.
- F. Contractor shall configure trending functions as directed by Owner including trend data collection and report format.
- G. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index. Point naming convention as follows.
 - 1. AA.BBB.CCDDE where
 - a. AA designates the location of the point within the building, such as a mechanical room, wing, level, or the building itself in a multi-building environment.
 - b. BBB designates the system which the point is associated. (e.g., A01 for air handler 1, HTG for heating water system, etc.)
 - c. CC designates the equipment or material referenced within the system. (e.g., SF for supply fan, HR for heating water return, etc.)
 - d. D or DD used for clarification or for identification if more than one CC exists.
 - e. E designates the action or state of the equipment or medium. (e.g., T for temperature, H for humidity, C for control, S for status, D for damper control, etc.)
- H. Configure three usernames with differing levels of privileges. Meet with Owner's Authorized Representative and coordinate access levels and privileges for each uses access.

3.08 GRAPHICS

- A. Provide graphics for all controlled systems and floor plans of the building. As a minimum, systems requiring graphics to include each chilled water system, hot water system, chiller, boiler, air handler, and all terminal equipment. Point information on the graphic displays shall dynamically update. On each graphic, show input and output points for the system. Also, show relevant calculated points such as setpoints. Input, output, and software point values shall be changeable from graphic screen. Provide link to a text file containing the automatic control sequence of operations.
- B. Meet with Owners Authorized Representative prior to beginning development of graphic displays to discuss Owner's preferences.
- C. Show terminal unit information on a "graphic" summary table. Provide dynamic information on each point shown.

3.09 CONTROL SYSTEM CHECKOUT AND TESTING

- A. Contractor shall completely test and verify specified control system performance. Compile test results and include with written certification.
- B. Contractor shall furnish all labor and test apparatus required to calibrate and prepare for service all instruments, controls, and accessory equipment furnished hereunder.
- C. Contractor shall perform the following testing and verification
 - 1. Verify that all control and communications wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.
 - 2. Enable control systems and verify instrument calibration and end-to-end reporting accuracy of all input devices individually. Perform calibration in accordance with manufacturers' recommendations. Repair or replace all temperature sensors requiring a calibration offset greater than /- 1°F.
 - 3. Verify control stability and end-to-end reporting requirements are met.
 - 4. Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that normal positions are correct.
 - 5. Verify that all analog output devices (I/Ps, actuators, etc.) are functional, start/stop and span are correct, and direction and normal position are correct.
 - 6. Verify that system operation complies with the sequence of operations. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all BAS control loops and optimum start/stop routines.

- 7. Alarms and Interlocks:
 - a. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
 - b. Trip interlocks using field contacts to check the logic and ensure that the fail-safe condition for all actuators is in the proper direction.
 - c. Test interlock actions by simulating alarm conditions to check the initiating value of the variable and the interlock action.
- D. Contractor shall maintain the following documentation:
 - 1. Calibration log including date, time, control system readout, means of verification, verification measurement, and required calibration offset for each analog input.
 - 2. BAS Loop Response: Supply trend data output in graphical form showing the step response of each BAS loop. The test shall show the loop's response to a change in set-point requiring a change in actuator position of at least 25% of full range. Provide sampling rate from 10 seconds to 1 minute depending on loop speed. Trend data shall show for each sample the setpoint, actuator position, and controlled variable values. Contractor shall retune any loop that indicates unreasonably under-damped or over-damped control.
 - 3. Demand Limiting: Supply trend data showing the action of any demand limiting functions. Document operation at maximum one-minute intervals for at least 30 minutes.
 - 4. Operational Logs: Provide operational trend logs for each system indicating setpoints, operating points, valve positions, mode, and equipment status. Logs shall cover three 48-hour periods and have a sample frequency of not more than 5 minutes. Logs provided in both printed and disk formats.
- E. After system operation is completely verified, provide written certification to Owner that systems have been fully tested and are operating according to specifications and ready for functional testing. Provide copies of documentation signed by person performing tests. Documentation to include:
 - 1. Calibration logs
 - 2. BAS Loop Response Trends
 - 3. Demand Limiting Trends
 - 4. Operational Logs

3.10 DEMONSTRATION AND ACCEPTANCE

- A. Demonstrate operation of control system to Owner and Engineer including:
 - 1. Menu functions
 - 2. Point overrides
 - 3. Control loop response after point modification
 - 4. Alarm response time

3.11 TRAINING

- A. Provide a minimum of 24 hours training to Owner's personnel in use and maintenance of BAS building management and control hardware and software. Training shall be provided in two (2) sessions of 8 hours each and two (2) sessions of 4 hours each as follows:
 - 1. The first session shall provide system overview and training on log on procedures, data access and display, alarm and status descriptions, log requests, execution of commands, and other general system operation procedures.
 - 2. The second session shall include instruction on system maintenance procedures. Procedures reviewed will include day-to-day system maintenance requirements, calibration techniques and diagnosis of system failures. Diagnosis procedures shall include instructions to follow in the event of failure of each control sub-system or device.
 - 3. Two remaining sessions shall include instruction on site-specific programs, graphics, and user interfaces.

B. Manufacturers Training: Provide 24-hour manufacturer training course for 3 Owner's Representatives. Training shall be provided on a variety of topic as selected by the Owner. Training shall be performed at manufacturer's designated locations.

END OF SECTION

SECTION 23 0925

BAS FIELD MOUNTED DEVICES FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Temperature Measurement
- B. Pressure Measurement
- C. Humidity Measurement
- D. Flow Measurement
- E. Relays and Switches
- F. Automatic Dampers
- G. Automatic Control Valves
- H. Actuators

1.02 RELATED SECTIONS

- A. SECTION 23 09 23 BUILDING AUTOMATION S STEMS FOR HVAC
- B. SECTION 23 09 29 BAS SEQUENCE OF OPERATIONS FOR HVAC

1.03 SUBMITTALS

- A. Provide submittals for products listed in the Product Table below in accordance with Section 23 05 00 – General HVAC Provisions. Submittal requirements indicated by column number designation as follows:
 - 1. Materials List
 - 2. Catalog Data
 - 3. Product Data
 - 4. Performance Data
 - 5. Wiring Diagrams
 - 6. Shop Drawings
 - 7. Installation Instructions
 - 8. Special Requirement listed herein.

PRODUCT TABLE	1	2	3	4	5	6	7	8
Temperature measurement								
Pressure measurement								
Humidity measurement								
Relays and switches								
Automatic dampers								
Automatic control valves								
Actuators								

1.04 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Control Contractor to coordinate with other trades to ensure delivery and correct installation of products furnished but not installed under this section. Coordination to include a review of schedule, manufacturer's installation requirements, and equipment locations. Such products include but are not limited to the following:
 - 1. Control valves
 - 2. Flow switches except where specifically indicated in other sections
 - 3. Temperature sensor wells and sockets
 - 4. Automatic dampers
- B. Control Contractor to provide all manufacturer's product information including recommended installation instructions to installing Contractor.

PART 2 PRODUCTS

2.01 TEMPERATURE MEASUREMENT

- A. Temperature Sensors
 - 1. Acceptable Manufacturers: Mamac, Precon, Veris, or approved Direct Digital Control System manufacturer. (Mamac and Precon may not make accessories for space temperature sensors needed for the project i.e., set point adjustment, override switch, display, communications port)
 - 2. Sensing element: Thermistor type, /- 0.5oF from 32oF to 150oF accuracy, less than 0.25oF drift/year. Compatible with BMCS analog input requirements. Select sensor with smallest range available that will span anticipated sensed medium temperature range.
 - 3. Space Air Sensor: Range 40 to 90oF, wall mounted with vandal-resistant heavy plastic or stainless-steel cover. Provide stainless-steel cage or other approved enclosure where sensors are susceptible to damage or vandalism.
 - a. Options: Provide the following space sensor options.
 - 1) Local set point adjustment
 - 2) Override switch
 - 3) Temperature display
 - 4) Communications port
- B. Temperature Transmitters
 - 1. Acceptable Manufacturer: Mamac, Precon, Veris, or approved Direct Digital Control System manufacturer.
 - 2. Sensing element: 100-ohm, platinum RTD, /- 0.65oF 70oF.
 - 3. Transmitters: 4 to 20 mA output. Select sensor with smallest range available that will span anticipated sensed medium temperature range. NEMA Type 4 rated Instrument head suitable for housing RTD wiring terminations and temperature transmitter and temperature sensor.
 - 4. Outside Air Sensor: Operating range -40 to 140oF, stainless-steel sensor sheath mounted in a weatherproof enclosure.
 - 5. Ductwork Averaging Sensor: Multiple sensing elements contained in soft aluminum tubing. Sensors shall be a minimum of 1 foot in length for every 2 square feet of duct area.
 - 6. Ductwork Probe Sensor: Aluminum or stainless-steel sensor sheath, sensor probe length suitable for application.
 - 7. Well Sensor: Aluminum or stainless-steel sensor sheath, sensor probe length suitable for application. Brass or stainless-steel thermal well rated to 250 psig and 250°F.

2.02 PRESSURE MEASUREMENT

- A. Air Pressure Transmitters.
 - 1. Acceptable Manufacturers: Mamac, Setra, Veris
 - 2. Sensor: Solid state, piezoresistive silicon chip pressure.
 - 3. Maximum operating pressure: 200% of design pressure
 - 4. Accuracy: /- 1% over operating range including linearity, repeatability, hysteresis, stability, and temperature compensation.
 - 5. Output: 4-20 mA or 0-5 VDC linear.
 - 6. Power Requirement: 24 VAC supply voltage with input power isolation
 - 7. Basis of Design: Mamac model PR-272
 - 8. Accessories:
 - a. Duct Installation: Provide duct mounted static pressure sensor probe.
- B. Water Pressure Transmitters:
 - 1. Acceptable Manufacturer: Mamac, Setra, Veris.
 - 2. General: Complete assembly consisting of sensing module, electronics housing, and piping connection manifold.
 - 3. Sensor: Encapsulated sensing element, AISI 316 stainless-steel where it contacts the working fluid.

- 4. Housing: NEMA Type 4
- 5. Manifold: Three valve, 316 stainless-steel vent and drain valves
- 6. Maximum operating pressure: 250 psi
- 7. Maximum operating temperature, 20oF to 175oF
- 8. Accuracy: /- 0.5 percent of calibrated span
- 9. Output: 4-20 mA or 0-5 vdc output signal
- 10. Input Range: Input range suitable for application
- 11. Basis of Design: Similar to Setra Model DPT 230
- C. Static Pressure Probe
 - 1. Acceptable Manufacturer: Dwyer, Air Monitor, Mamac, or approved Direct Digital Control System manufacturer.
 - 2. General: ¹/₄ brass tubing, 12-inch insertion depth.

2.03 HUMIDITY MEASUREMENT

- A. Relative Humidity Transmitter:
 - 1. Acceptable Manufacturer: Mamac, Veris, Vaisala
 - 2. Sensor: Solid state, copolymer wafer sensor. Operating range 0 100 RH.
 - 3. Accuracy: /-2% accuracy, temperature compensated.
 - 4. Output: 0-5 VDC, 4/20 mÅ linear output compatible with BAS manufacturer.
 - 5. Power Supply: 24 VAC supply voltage with input power isolation
 - 6. Basis of Design: Mamac model HU-222

2.04 RELAYS AND SWITCHES

- A. Push Buttons, Position Selector Switches, Manual Operating Switches.
 - 1. General: UL listed, industrial grade
- B. Single Phase Motor Control Relays:
 - 1. Acceptable Manufacturer: Greenheck, Veris,
 - 2. General: Industrial grade load-switching relay, current status switch, and Hand-Off-Auto switch for control or fractional horsepower single phase motors. The relay, current sensor, and HOA switch are combined in a series circuit. Once an H5xx is wired in series between the power source and motor, all three components are installed.
 - 3. Relay: Contacts rated for connected motor load, SPST relay is field-selectable for N.O. or N.C. operation. LED status indicator light.
 - 4. Current Status Switch: Adjustable setpoint.
 - 5. Housing: Surface mounted. The housing provides physical separation and multiple wiring exits to isolate control and high voltage wiring.
 - 6. Similar to Veris, Hawkeye Model 500 Series
- C. Current Status Switches for Constant Load Devices, Adjustable Trip
 - 1. Acceptable Manufacturer: Hawkeye or approved equal.
 - 2. General: Factory programmed current sensor to detect motor undercurrent situations such as belt or coupling loss on constant loads. Sensor shall store motor current as operating parameter in non-volatile memory. Push-button to clear memory.
 - 3. Visual LED indicator for status
 - 4. Split core sensor, induced powered from monitored load and isolated to 600 VAC rms. Sensor shall indicate status from 2.5 A to 135 A
 - 5. Normally open current sensor output. 0.1A at 30 VAC/DC
 - 6. Similar to Hawkeye Model 908
- D. Current Status Switches for Variable Frequency Drive Application, Adjustable Trip
 - 1. Acceptable Manufacturer: Hawkeye or approved equal.
 - 2. General: Factory programmed current sensor to detect motor undercurrent situations such as belt or coupling loss on variable loads. Sensor shall store motor current as operating parameter in non-volatile memory. Push-button to clear memory.
 - 3. Visual LED indicator for status
 - 4. Split core sensor, induced powered from monitored load and isolated to 600 VAC rms. Sensor shall indicate status from 5 A to 135 A and from 5 to 75 Hz

- 5. Normally open current sensor output. 0.1A at 30 VAC/DC
- 6. Similar to Hawkeye Model H904
- E. Current Status Switches, Fixed Trip
 - 1. Acceptable Manufacturer: Hawkeye or approved equal.
 - 2. General: Fixed trip point current switch.
 - 3. Split core sensor, induced powered from monitored load and isolated to 600 VAC rms. Sensor shall indicate status from .25 A to 200 A.
 - 4. Normally open current sensor output. 0.1A at 30 VAC/DC
 - 5. Similar to Hawkeye Model H800
- F. High Differential Pressure Switch
 - 1. Static pressure/electric relay to detect dirty air filter or fan over-pressure condition. Diaphragm operated contact. Adjustable setpoint range.
- G. Low Temperature Limit Switch (Freeze Protection Relay)
 - 1. Low temperature cutout relay. SPDT contact. Adjustable setpoint from 35 degrees F to 50 degrees F.
 - 2. Fixed differential sensing element. Minimum 1 lineal foot of element per 1 square foot of coil area.
 - 3. Manual reset
- H. Condensate Drain Pan High Level Switch

2.05 AUTOMATIC DAMPERS

- A. Acceptable Manufacturer: Greenheck, Ruskin, Tamco, or approved BAS manufacturer
- B. General: Opposed blade or parallel blade as indicated below or as shown on Drawings.
 - 1. Provide parallel blade dampers for outdoor/return air mixing dampers and face and bypass dampers. Arrange to direct air streams toward each other for optimum mixing.
 - 2. Provide opposed blade dampers for all other modulating applications.
 - 3. Two-position shutoff may be opposed blade or parallel blade type with blade and side seals.
 - 4. Individual damper sections not larger than 48 inches x 60 inches.
- C. Construction:
 - 1. Frames: 13-gauge galvanized steel or 1/8-inch aluminum with reinforced corner bracing.
 - 2. Blades:
 - a. Style: Airfoil-shaped, single-piece
 - b. Action: Parallel or opposed blade as specified
 - c. Orientation: Horizontal or vertical with thrust washers as shown on Drawings.
 - d. Material: Heavy duty 6063-T5 extruded aluminum
 - e. Width: Maximum 6 inches
 - f. Insulation: Provide insulated blades where dampers are installed exterior to the building envelope opening. Complete blade shall have an insulating factor of R-2.2.
 - 3. Bearings: Molded synthetic sleeve or equal
 - 4. Seals:
 - a. Blade: Extruded EPDM. Mechanically attached to blade edge
 - b. Jamb: Flexible metal compression type or equal
 - 5. Linkage: Concealed in frame
 - 6. Finish: Mill aluminum
- D. Performance Data:
 - 1. Temperature Rating: Withstand -72 to 275 degrees F
 - 2. Capacity: Demonstrate capacity of damper to withstand HVAC system operating conditions.
 - a. Closed Position: Maximum pressure of 13 inches w.g. a 12-inch blade length.
 - b. Open Position: Maximum air velocity of 6,000 feet per minute.
 - 3. Leakage: Maximum 5.2 cubic feet per minute per square foot at 4 inches w.g. for size 48 x 48 inches.
 - 4. Pressure Drop: Maximum 0.03-inch w.g. at 1,500 feet per minute across 24-inch x 24-inch damper.

2.06 LOW LEAKAGE THERMALLY INSULATED CONTROL DAMPERS

- A. Acceptable Manufacturers: Tamco Series 9000 or approved.
- B. General: Opposed blade or parallel blade as indicated below or as shown on Drawings.
 - 1. Provide parallel blade dampers for outdoor/return air mixing dampers. Arrange to direct air streams toward each other for optimum mixing.
 - 2. Provide opposed blade dampers for all other modulating applications.
 - 3. Two-position shutoff may be opposed blade or parallel blade type with blade and side seals.
 - 4. Individual damper sections not larger than 48 inches wide x 60 inches tall.
 - 5. Damper actuator shall be factory installed by damper manufacturer as integral part of damper assembly. Coordinate actuator location and mounting requirements with damper manufacturer.
- C. Construction
 - 1. Frame:
 - a. Material: ASTM B 211, Alloy 6063 T5 extruded-aluminum profiles,0.08 inch thick.
 - b. Hat-shaped channel with integral flange(s). Mating face shall be a minimum of 1 inch.
 - c. Width: 6 inches.
 - 2. Blades:
 - a. Airfoil, extruded aluminum.
 - b. Material: ASTM B 211, Alloy 6063 T5 aluminum, 0.06 inch thick.
 - c. Blades internally insulated with expanded polyurethane foam and shall be thermally broken have insulating factor of R-2.3 and a temperature index of 55 tested to AAMA 1502.7.
 - d. Blades shall be custom fabricated with blade stops not exceeding 1.25".
 - e. Width not to exceed 6.5 inches.
 - f. Length as required by close-off pressure, not to exceed 48 inches.
 - 3. Seals:
 - a. Blades: EPDM secured in integral slot within frame extrusion and mechanically fastened.
 - b. Jambs: extruded silicone secured in integral slot within frame extrusion and mechanically fastened.
 - 4. Control shaft: 0.5-inch-diameter zinc plated or stainless-steel, mechanically attached to blades.
 - 5. Bearings:
 - a. Celcon outer bearing rotating within a polycarbonate outer bearing inserted in frame.
 - b. Where blade axles are installed in vertical position, provide thrust bearings.
 - 6. Linkage:
 - a. Concealed in frame out of air steam, accessible.
 - b. Constructed of aluminum and zinc plated or stainless-steel.
 - c. Hardware: Stainless-steel.
- D. Performance Data:
 - 1. Leakage: AMCA 511, Class 1A. Leakage shall not exceed 3 cfm/sq. ft. against 1-in. wg differential static pressure.
 - 2. Pressure Drop: 0.05-in. wg at 1500 fpm across a 24-by-24-inch damper when tested according to AMCA 500-D, figure 5.3.
 - 3. Velocity: Up to 6000 fpm.
 - 4. Temperature: Minus 40 to plus 210 deg F.
 - 5. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.
 - 6. Damper shall have AMCA seal for both air leakage and air performance.

2.07 AUTOMATIC CONTROL VALVES

- A. Acceptable Manufacturer: Belimo or approved BAS manufacturer
- B. General: Two-way or three-way type for two position or modulation service.

- C. Close-off Pressure Rating: Valve trim and valve actuator furnished to provide the following minimum close-off pressure ratings
 - 1. Water Valves:
 - a. Two-way valves: 150% of total system (pump) head.
 - b. Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system pump head.
- D. Water Valves:
 - Two-way Modulating 2-inch and below: Fully proportional, modulating ball valve. Equal percentage flow characteristics. Brass body with nickel plating, stainless-steel ball, fiberglass reinforced Teflon seats, blow out proof stem, TEF ZEL characterizing disc, stainless-steel trim. 400 psi maximum rated pressure, 0-212°F temperature rating, 200 psi close off pressure, 20 psi maximum operating differential pressure. Rangeability 500 to 1.
 - 2. Two-way Modulating 2-1/2 inch and above: Fully proportional, modulating globe valve. Single seat with equal percentage flow characteristics. Stainless-steel or bronze trim, stainless-steel stem, composition disc, replaceable bronze or stainless-steel seats. ANSI Class 125 cast iron body, flanged ends.
 - 3. Three-way Modulating 2-inch and below: Fully proportional, modulating ball valve. Equal percentage flow characteristics. Brass body with nickel plating, stainless-steel ball, fiberglass reinforced Teflon seats, blow out proof stem, TEF ZEL characterizing disc, stainless-steel trim. 400 psi maximum rated pressure, 0-212°F temperature rating, 100 psi close off pressure each port, 50 psi maximum operating differential pressure. Rangeability 500 to 1. End position switches for normally open and normally closed port.
 - 4. Three-way Modulating 2-1/2 inch and above: Fully proportional, three-way mixing globe valve. Linear flow characteristic each port. Bronze or stainless-steel trim, bronze replaceable seats. ANSI Class 125, cast iron body, flanged ends.
 - 5. Three-way 2-position 2-inch and below: Full port ball valve. Brass body with nickel plating, stainless-steel ball, fiberglass reinforced Teflon seats, blow out proof stem, TEF ZEL characterizing disc, stainless-steel trim. 400 psi maximum rated pressure, 0-212°F temperature rating, 100 psi close off pressure each port.
 - 6. Sizing Criteria: Size valves to provide CV scheduled on Drawings. If CV is not scheduled, size valves as indicated below.
 - a. Two-position service: Line size
 - b. Two-way modulating service: Pressure drop equal to twice the pressure drop through the associated heat exchange device, 50% of the pressure difference between supply and return mains, or 5 psi, whichever is greater.
 - c. Three-way modulating service: Pressure drop equal to twice the pressure drop through the associated heat exchange device, 5 psi maximum.
 - 7. Failure Mode:
 - a. Heating Water Coils: Normally open
 - b. Chilled Water Coils: Normally closed

2.08 ACTUATORS

- A. Acceptable Manufacturers: Belimo or approved equal.
- B. Proportional Electric Actuator:
 - 1. Direct coupled, spring return. Fully proportioning with ample power to operate valve or damper against fluid pressures and mechanical friction.
 - 2. Size to provide specified valve shut-off pressure or damper differential pressure.
 - 3. 0 to 10 VAC or 4 to 20 mA input control signal.
 - 4. 24 VAC supply power. Suitable for use with Class 2 wiring. Maximum 10 VA for AC installations and 8 watts for DC applications.
 - 5. Actuator shall have electronic overload or digital rotation circuitry to prevent damage to actuator through entire rotation range.
 - 6. Actuators shall initialize when actuator is powered. Initialization will determine stroke length and enable actuator to set minimum and maximum limits of supplied control signal

to ensure use of entire control signal range. Feedback automatically adjusted to the effective stroke.

- 7. Provide manual override and visual position indicator.
- 8. Provide 2 to 10 VDC position feedback signal corresponding to actual valve or damper position.
- 9. Provide NEMA Type 1 enclosures.
- 10. Globe Valve Service:
 - a. Provide with automatic coupling device locking actuator to valve stem.
- 11. Damper Service:
 - a. Direct shaft-mounted
 - b. Provide one actuator per damper section. No connecting rods or jack shafts allowed except where indicated on control drawings.
 - c. Provide positive method of attaching actuator to damper shaft. If single bolt or set screw is used, mill flat side on damper shaft to avoid slippage.
- C. Two Position Electric Actuator
 - 1. Direct coupled, spring return or last position as required. Ample power to operate valve or damper against fluid pressures and mechanical friction.
 - 2. Size to provide specified valve shut-off pressure or damper differential pressure.
 - 3. 0 to 24 VAC input control signal.
 - 4. 24 VAC supply power. Suitable for use with Class 2 wiring. Maximum 10 VA for AC installations and 8 watts for DC applications.
 - 5. Actuator shall have electronic overload or digital rotation circuitry to prevent damage to actuator through entire rotation range.
 - 6. Provide manual override and visual position indicator.
 - 7. Provide 2 to 10 VDC position feedback signal corresponding to actual valve or damper position.
 - 8. Provide NEMA Type 1 enclosures.
 - 9. Damper Service
 - a. Direct shaft-mounted
 - b. Provide one actuator per damper section. No connecting rods or jack shafts allowed except where indicated on control drawings.
 - c. Provide positive method of attaching actuator to damper shaft. If single bolt or set screw is used, mill flat side on damper shaft to avoid slippage.

PART 3 EXECUTION

3.01 INSTALLATION

A. Locate field-mounted devices as shown on Drawings and install per manufacturers recommendations.

3.02 SENSORS AND TRANSMITTERS

- A. Provide temperature sensor for space temperature sensing applications.
- B. Provide temperature transmitter for the following applications:
 - 1. Outside Air Temperature
 - 2. Ductwork Temperature with Averaging Sensor
 - 3. Ductwork Temperature with Probe Sensor
 - 4. Hydronic System Temperature with Probe Sensor
- C. Space Temperature Sensors:
 - 1. Mount on wall or on ceiling pendant as shown on Drawings.
 - 2. For wall installation, mount on wall 60 inches above finished floor level in concealed junction boxes properly supported by wall framing.
 - 3. For ceiling installation, mount on minimum 24-inch pendant, but not less than 84 inches above finished floor level.
 - 4. Locate space temperature sensor to avoid localized heating or cooling effects from space equipment, lights, or diffusers.

- 5. All wires attached to sensors shall be air sealed in their raceways to prevent air transmitted from other areas from affected sensor accuracy.
- D. Outside Air Temperature Transmitter:
 - 1. Mount on north walls
 - 2. Mount inside ventilated sun shield to minimize radiant energy and wind effects.
- E. Ductwork Temperature Transmitters:
 - 1. Duct mounted sensors duct mounted in electrical box on duct exterior.
 - 2. For outdoor applications, provide a weatherproof mounting box with weatherproof cover and gasket.
- F. Ductwork Averaging Temperature Transmitter: Provide for mixed air applications, ductwork with a cross sectional dimension greater than 48 inches, and any application where non-uniform air temperature exists.
- G. Ductwork Probe Temperature Transmitter: Size to position tip of probe in middle of air steam.
- H. Hydronic System Temperature Transmitter:
 - 1. Coordinate with Mechanical Contractor to ensure that associated temperature wells are installed where required and located for optimum sensing accuracy.

3.03 WATER DIFFERENTIAL PRESSURE TRANSMITTER

- A. Install transmitter to measure pressure differential between supply and return piping approximately 2/3 of the distance from the pump outlet to the connection of the furthest coils.
- B. Install transmitter within 60 inches of floor where possible. Provide piping and valves to drain and clean instrument piping.

3.04 RELAYS AND SWITCHES

- A. Current Status Switches:
 - 1. Provide current status switch to monitor status of all motor-driven equipment where status is required.
 - 2. Wrap power conductor through current transformer multiple times to amplify current signal where required.
 - 3. Provide enclosure adjacent to existing motor starter when space in starter is not adequate to house current status switch.
- B. Low Temperature Limit Switches:
 - 1. Sensors elements shall be installed to protect entire face of coils
 - 2. To allow testing, install with 12-inch loop of sensing element outside of fan housing. Not applicable for outdoor installations.

3.05 AUTOMATIC DAMPERS

- A. Provide a minimum of one damper actuator per damper section.
- B. Unless specifically designed for vertical blade application, dampers mounted with blades horizontal.
- C. Provide a visible and accessible indication of damper position on the drive end shaft.
- D. Caulk between damper frame and ductwork to prevent leakage around perimeter of damper

3.06 AUTOMATIC VALVES

- A. Install all slip-stem control valves with stem position no more than 60 degrees from vertical.
- B. Locate to allow access and service. Ensure that actuator can be removed and services without interference from structure of other piping and equipment.
- C. Contractor shall verify that control valve port arrangement provides the intended valve function when installed as shown on Drawings. Notify Engineer of any potential conflict between the installation plans and control valve installation requirements prior to start of associated work. Any control valves installed with incorrect connections will be re-piped to provide correct operation at no expense to the Owner.

3.07 ACTUATORS

- A. Damper actuators shall not be installed in the air stream unless specified shown on Drawings.
- B. Provide weather shield where actuators are mounted outside of conditioned space.
- C. Provide air gaps, thermal isolation washers or spacers, standoff legs, or insulation if required to ensure that actuator ambient temperature does not exceed actuator rating.
- D. Actuator cords or conduit shall incorporate a drip leg if condensation is possible.

END OF SECTION

SECTION 23 0929

BAS SEQUENCE OF OPERATIONS FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description of Control Sequences.

1.02 WORK INCLUDES

- A. The control system will consist of all necessary devices and software to provide the sequences of operation described herein.
- B. Provide custom engineered BAS operating software to perform control sequences specified. Sequence of operations describes major control functions but does not limit Contractor's responsibility to provide a fully operational automatic control system. Contractor shall provide additional control functions not specifically described herein including time delays, control deadbands, equipment interlocks, equipment sequencing, alarm notification, control functions recommended by equipment manufacturers, or as otherwise required.

1.03 SUBMITTALS

- A. Provide submittals for products listed in the Product Table below in accordance with Section 23 05 00 – General HVAC Provisions. Submittal requirements indicated by column number designation as follows:
 - 1. Materials List
 - 2. Catalog Data
 - 3. Product Data
 - 4. Performance Data
 - 5. Wiring Diagrams
 - 6. Shop Drawings
 - 7. Installation Instructions
 - 8. Special Requirements listed herein.

PRODUCT TABLE	1	2	3	4	5	6	7	8
All Products This Section								

B. Special Requirements: Provide a complete written sequence of operations for each system or subsystem under all modes of operation. Where Contractor proposes any variation to the sequence of operation described hereunder, the Contractor shall specifically highlight the change and describe the reason for the revision.

1.04 DESIGN REQUIREMENTS

- A. All safety control circuits interlocked with motor starters or VFDs shall be hardwired and shall function in all operating modes (Automatic, Hand, and Manual Bypass).
- B. Provide freeze protection switches for all air handlers that are designed to provide outside air ventilation rates that exceed 30% of the supply airflow rate and have water (non-glycol) heating or cooling coils. Locate freeze protection sensor elements upstream of all water coils, except locate sensor downstream of heating coils that have coil circulation pumps that maintain a constant coil water flow or that have a freeze protection solution.
- C. Control setpoints and parameters listed in control sequences are initial values. Adjust setpoints and control parameters as directed by Engineer to achieved desired environment conditions, optimum system performance, and as recommended by TAB contractor.
- D. Control setpoints shall be adjustable from the Operator Workstation without modification of control programming or use of proprietary software. All setpoints which are necessary for normal operation and optimization of system performance as required by Owner shall be adjustable, and shall include, but not be limited to: time schedules; temperature, pressure, humidity, and CO₂ setpoints; time delay settings; safety sequence setpoints; and alarming parameters.

- E. Where BAS network communications are provided to networkable control systems or equipment, Contractor shall configure accessible points for control, monitoring, and alarm as required to provide specified sequences and as directed by the Owner's Authorized Representative for trending and monitoring.
- F. All cascade control sequences and closed control loops shall have proportional-integral action and derivative capability, except where approved otherwise.
- G. Provide BAS alarm functions and configuration as detailed in plans and specifications, and as directed by Owner's Authorized Representative. Alarm functions may include:
 - 1. Visual display on workstation graphic.
 - 2. Audible alarm at workstation computer.
 - 3. Listing in workstation alarm log.
 - 4. "Pop-up" alarm notification at workstation computer.
 - 5. Dial-out alarm to Owner's security staff or alarm monitoring service.
- H. Control system shall be designed to automatically and reliably restore HVAC system to normal operation when a utility power interruption occurs and when utility power is restored. Normal operation shall be fully restored for critical systems within 1 minute after the automatic transfer switch transfers power to the generator and when the power is transferred back to utility service. Equipment start-up shall be managed to prevent excessive start-up load on the generator.

PART 2 PRODUCTS

2.01 CHILLED WATER SYSTEM CH 1, CWP 1 THROUGH 4, AND AV 1

- A. General: Variable volume primary only chilled water system with one air-cooled scroll water chiller, primary chilled water distribution pumps, and chilled beam pumps. Chiller system is enabled by BAS. Chilled water temperature control is maintained by packaged chiller controls. Primary distribution pumps are arranged as lead/lag and are controlled by the BAS through the chiller control panel signal. Chilled beam distribution pumps are arranged as lead/lag and controlled by the BAS.
 - 1. Primary Chilled Water System: Chilled water provided by the air cooled chiller CH-1 will be circulated to dedicated outside air system cooling coils, and fan coil cooling coils at 44°F.
 - 2. Chilled Beam System: A second chilled water distribution system will provide chilled water to chilled beams at approximately 58°F.
- B. Chilled Water System Enable/Disable:
 - 1. Enable chilled water system if any chilled water control valve is more than 15% open and DOAS-1 is on.
 - 2. Disable chilled water system if all chilled water control valves are closed for more than 5 minutes or DOAS-1 is off.
- C. Chiller Operating Mode (CH-1)
 - 1. Enable chiller whenever the chilled water system is enabled.
 - 2. Disable chiller operation whenever the chilled water system is disabled.
- D. Primary Pump Control (CWP-1 and CWP-2)
 - 1. Enable and disable lead pump upon signal from chiller control panel.
 - 2. Lag pump starts if lead pump status indicates that the lead pump has failed.
 - 3. Lag pump stops if lead pump status is restored.
 - 4. Lead pump shall have a minimum 10-minute runtime once enabled.
 - 5. Chiller control panel automatically alternates lead pump weekly.
- E. Primary Pump Speed Control (CWP-1 and CWP-2)
 - 1. Modulate pump speed to maintain a chilled water pressure differential between supply and return piping. Pressure setpoint determined by TAB contractor. Locate pressure transmitter where shown on drawings.
- F. Chilled Beam Pump Control (CWP-3 and CWP-4)
 - 1. Enable and disable lead pump upon signal from chiller control panel.
 - 2. Lag pump starts if lead pump status indicates that the lead pump has failed.
 - 3. Lag pump stops if lead pump status is restored.

- 4. Lead pump shall have a minimum 10-minute runtime once enabled.
- 5. Chiller control panel automatically alternates lead pump weekly.
- G. Chilled Beam Pump Speed Control (CWP-1 and CWP-2)
 - 1. Modulate pump speed to maintain a chilled water pressure differential between supply and return piping. Pressure setpoint determined by TAB contractor. Locate pressure transmitter where shown on drawings.
- H. Chilled Water Supply Temperature Control
 - 1. The packaged chiller control system shall control and maintain chilled water temperature setpoint. Refer to Section 23 64 24 Scroll Water Chillers, Air-Cooled.
- I. Chilled Beam Water Supply Temperature Control
 - 1. Chilled water system enabled: Modulate chilled water control valve AV-1 to maintain a building chilled beam water supply temperature of 58°F.
 - 2. Chilled water system disabled: Close control valve.
 - 3. Low chilled beam supply water temperature alarm: Stop pump CWP-3 and CWP-4 and close AV-1 whenever alarm is on.
- J. Safety Controls: Override normal operating modes whenever the following emergency conditions occur.
 - 1. Chiller Alarm: Provide chiller failure alarm. Maintain alarm until acknowledged by operator.
 - 2. Chilled Water System Failure: If the chilled water supply temperature is more than 10°F above setpoint for more than 40 minutes, activate Critical Chilled Water System Alarm. Maintain alarm until acknowledged by operator. Activate alarm if chilled water system is enabled and after a 60-minute start-up delay to allow for system cool-down.
 - 3. Low Chilled Beam Supply Water Temperature Alarm: If the chilled water supply temperature to chilled beams is more than 5°F below setpoint for more than 30 minutes, activate Critical Low Chilled Beam Supply Water Temperature Alarm. Maintain alarm until acknowledged by operator. Activate alarm timer 30 minutes after system start-up to allow for system cooling down.
 - 4. Pump Status: If a motor is commanded "on" and the motor status after a 20 second delay indicates that the motor is off, activate status alarm. Maintain alarm until acknowledged by building operator.
- K. Input/Output Points List: See diagrams on drawings.

2.02 HEATING WATER SYSTEM B 1 AND B 2, BP 1 AND BP 2, HWP 1 AND HWP 2

- A. System Description: Two condensing boilers provide heat to building with primary/secondary pumping configuration. Boiler operation is controlled by packaged boiler controls and by a boiler controller (BMP) furnished by the boiler manufacturer.
- B. Heating water system Enable/Disable:
 - 1. Enable heating water system when any of the following conditions occur:
 - a. Enable heating water system if any heating water control valve is more than 15% open and DOAS-1 is on.
 - b. DOAS-1 freeze protection alarm is on.
 - 2. Disable heating water system when all the following conditions occur:
 - a. Disable heating water system if all heating water control valves are closed for more than 5 minutes or DOAS-1 is off.
- C. Boilers (B-1 & 2):
 - 1. Enable boilers whenever the heating water system is enabled.
 - 2. Disable boilers operation whenever the heating water system is disabled.
- D. Boiler Water Pump (BP-1 and BP-2)
 - 1. Enable boiler water pump upon signal from associated boiler control panel.
- E. Heating Water Pump Motor Control (HWP-1 and HWP-2)
 - 1. Operate pump motors to individual On-Off-Auto switch at motor controller as follows:
 - 2. Auto position: Operate motor subject to BAS control signal.

- 3. On position: Override automatic control and start motor. Safety control sequences enabled.
- 4. Off position: Motor off.
- F. Heating Water Pump Staging Control (HWP-1 and HWP-2)
 - 1. Enable and lead pump whenever the heating system is enabled.
 - 2. Enable Lag pump if lead pump status indicates that the lead pump has failed.
 - 3. Lag pump stops if lead pump status is restored.
 - 4. Lead pump shall have a minimum 10-minute runtime once enabled.
 - 5. BAS automatically alternates lead pump weekly.
- G. Heating Water Pump Speed Control (HWP-1 and HWP-2)
 - 1. Modulate pump speed to maintain a heating water pressure difference between supply and return piping. Pressure setpoint determined by TAB contractor.
- H. Supply Water Temperature Control
 - 1. Initial heating supply water temperature of 120°F.
 - 2. Reset supply water temperature setpoint from a maximum of 120°F at 40oF outside air to a minimum of 100°F at 65°F outside air and above,
- I. Boiler Control
 - 1. BAS enable boiler controller after the heating water system enable conditions are met
 - 2. Once enabled the boilers shall be enabled for a minimum of 20 minutes.
 - 3. BAS to provide heating water supply temperature setpoint to boiler controller. Reset water temperature as follows:
 - a. Provide linear reset between 40oF and 65oF.
 - b. When outside air temperature is 40oF and below, 120oF.
 - c. When outside air temperature is 65oF and above, 100oF.
 - 4. Boiler packaged controller to include start/stop sequencing of constant flow boiler pumps BP-1 and BP-2.
 - 5. Boiler packaged controller to operate boilers and modulate boiler firing to maintain heating water temperature setpoint. Refer to 23 52 16 Condensing Boilers.
 - 6. BAS contractor to install boiler supply temperature transmitter furnished with boiler controller.
 - 7. BAS contractor to provide communications wiring connection between BAS and boiler controller.
- J. Safety Controls: Override normal operating modes whenever the following emergency conditions occur.
 - 1. Boiler Alarm: Monitor boiler alarm contacts. Display alarm on workstation graphic display.
 - Heating water system failure: If the heating water supply temperature is more than 10°F below setpoint for more than 30 minutes, activate Critical Heating Water System Alarm. Maintain alarm until acknowledged by operator. Activate alarm if heating water system is enabled and after a 60-minute start-up delay to allow for system warm-up.
 - 3. Pump status: If a motor is commanded "on" and the motor status after a one-minute delay indicates that the motor is "off", activate status alarm. Maintain alarm until acknowledged by building operator.
- K. Input/Output Points List: See diagram on Drawings.

2.03 DEDICATED OUTSIDE AIR SYSTEM DOAS 1

- A. General: Variable volume dedicated outside air distribution system (DOAS). The DOAS system is a packaged unit consisting of supply fans, exhaust fans, heat exchanger with face and bypass dampers, heating water coil, and chilled water coil. The DOAS unit will be used for 100 percent outside air ventilation.
- B. Time control:
 - 1. Occupied Mode: Provide time schedule to define occupied times for each day of the week and holidays.
 - 2. Unoccupied Mode: Enable whenever occupied mode is not enabled.

- C. Occupied Mode:
 - 1. Mode control: Enable during occupied mode in accordance with Time Control.
 - 2. Damper Control: Open outside air and exhaust air dampers and close bypass dampers whenever the supply fan is on.
 - 3. Fan Operation: Supply and exhaust fans on.
 - 4. Discharge air temperature setpoint and control: Operate in accordance with discharge air temperature setpoint and discharge air temperature control.
- D. Unoccupied Mode:
 - 1. Mode control: Disable during unoccupied period in accordance with Time Control.
 - 2. Damper Control: Close outside air and exhaust air dampers and open bypass dampers whenever the supply fan is off.
 - 3. Fan operation: Supply and exhaust fans off.
 - 4. Coil Control Valves closed.
- E. Night Low Limit Mode:
 - 1. Mode Control: enable during unoccupied periods if any space temperature is below 58°F. Disable when all space temperatures are above 60°F.
 - 2. Damper control: Close the outside air and exhaust air dampers and open the bypass dampers.
 - 3. Fan operation: Supply and exhaust fans on.
 - 4. Fan speed: Operate in accordance with Fan Speed Control.
 - 5. Discharge air temperature control: Operate in accordance with Discharge Air Temperature Control. Discharge air temperature of 70°F.
- F. Motor Control: Operate subject to individual On-Off-Auto switch at motor controller as follows:
 - 1. Auto Position: Operate motor subject to BAS control signal and hardwired safety control interlocks.
 - 2. On Position: Override automatic control and start motor. Operate motor subject to hardwired safety control interlocks.
 - 3. Off position: Motor off.
- G. Fan Speed Control
 - 1. Supply Fan: Modulate supply fan speed control to maintain duct static pressure setpoint at location shown on drawings. Static pressure setpoint determined by balancing contractor.
 - 2. Exhaust Fan: Modulate supply fan speed control to maintain duct static pressure setpoint at location shown on drawings. Static pressure setpoint determined by balancing contractor.
- H. Discharge Air Temperature and Humidity Setpoints:
 - 1. Temperature Setpoint: Reset setpoint subject to outside air temperature from a maximum of 68°F at 45°F outside air to a minimum of 55°F at 75°F outside air.
 - 2. Humidity Setpoint: If the outside air dewpoint is greater than 54°F, override the discharge air temperature setpoint to maintain a discharge air dewpoint of no less than 54°F.
- I. Discharge Air Temperature Control: Modulate heat exchanger outside air face and bypass dampers, heating coil control valve, and cooling coil control valve in sequence to maintain discharge air temperature setpoint. Modulate in the following sequence.
 - 1. Full heat: Heating coil valve open, heat exchanger outside air face damper open, coil circulation pump enabled. cooling coil valve closed.
 - 2. As heating load reduces, modulate heating coil valve closed. Heating coil circulation pump remains enabled
 - 3. As heating load further reduces, modulate heat exchanger face damper from open with heating and cooling coil valves closed. Heating coil circulation pump disabled.
 - 4. When cooling is required, modulate cooling coil valve and face and bypass damper according to operating mode as follows:
 - a. Modulate cooling coil control valve to maintain air handling unit discharge air temperature setpoint.
 - b. Humidity control: Modulate cooling coil valve to maintain a cooling coil discharge air temperature of 55oF.
- c. Heat recovery: Close outside air face dampers, unless the outside air temperature is greater than the exhaust air temperature then open the heat exchanger face damper.
- J. Safety Controls: Override normal operating modes whenever the following emergency conditions occur.
 - 1. Smoke detection: Stop supply and exhaust fans when smoke detector is activated. Associated valves and dampers set to unoccupied mode position. Electrically interlock to motor controller. Maintain alarm until acknowledged by building operator.
 - 2. Freeze Protection (hardware): Activate freeze protection alarm when supply temperature is less than 38°F. Stop supply and exhaust fans. Associated valves and dampers set to unoccupied mode position, except heating coil control valve set to 100% open. Electrically interlock to fan starter. BAS to automatically restart when alarm status is normal. Maintain alarm until acknowledged by building operator.
 - 3. Fan status: If a motor is commanded "on" and the motor status after a one minute delay indicates that the motor is "off", activate status alarm. Stop supply and exhaust fans. Associated valves and dampers set to unoccupied mode position. Maintain alarm until acknowledged by building operator.
- K. Input / Output Points List: See Diagram on Drawings.

2.04 CHILLED BEAMS

- A. General: 2-pipe and 4-pipe active chilled beams.
- B. Space temperature control:
 - 1. Warm-up, Cool down, Occupied mode:
 - a. Heating: Modulate heating coil control valve to maintain space heating setpoint of 70°F.
 - b. Cooling: Modulate cooling coil control valve to maintain space cooling setpoint of $74^{\circ}\text{F}.$
 - 2. Unoccupied mode: Heating and cooling coil control valve closed.
- C. Input / Output Points List: See diagram on drawings

2.05 EXHAUST FAN EF 1

- A. Space temperature control, constant volume.
- B. Period of operation: Operate exhaust fan whenever mechanical room air temperature is greater than 78°F. Disable exhaust fan and close exhaust and outside air inlet dampers when space temperature is less than 75°F.
- C. Damper operation: Electrically interlock exhaust air damper and outside air inlet damper with exhaust fan motor. Open dampers when fan is on and close dampers when fan is off.
- D. Safety Controls: Override normal operating modes whenever the following emergency conditions occur.
 - 1. Fan status: If a motor is commanded "on" and the motor status after a one minute delay indicates that the motor is "off", activate status alarm. Stop supply and exhaust fans. Associated valves and dampers set to unoccupied mode position. Maintain alarm until acknowledged by building operator.
- E. Input / output points list: See diagram on drawings.
- 2.06 FAN COIL UNIT WITH HYDRONIC HEATING AND COOLING COILS FC 1.2, FC 1.3, FC 1.4, FC 2.2, AND FC 2.3
 - A. General: Variable volume 2-pipe and 4-pipe fan coil unit with fixed minimum outside air ventilation.
 - B. Operating Schedule:
 - 1. Unit are enabled continuously.
 - C. Space temperature setpoints:
 - 1. Heating: 70°F
 - 2. Cooling: 75°F

- D. Normal Mode:
 - 1. Fan Operation: Supply fans on.
 - 2. Space Temperature Control:
 - a. Heating: Modulate heating coil control valve from fully closed to fully open.
 - b. Cooling: Modulate cooling coil control valve from fully closed to fully open.
 - c. Deadband: If the space temperature is greater than the heating setpoint and less than the cooling setpoint then operate as follows:
 - 1) Heating and cooling coil control valves closed.
- E. Exercise room variable outside air. (FC-1.2)
 - 1. Modulate outside air branch duct damper open and return damper shut between minimum and maximum settings to maintain a CO2 concentration of 900 PPM. Damper setpoints determined by balancing contractor.
 - a. Minimum Outside Air: 100 cfm
 - b. Maximum Outside Air: 400 cfm
- F. Safety Control:
 - 1. Space Temperature Alarm: If the space temperature exceeds 80°F, activate status alarm. Maintain alarm until acknowledged by building operator.
 - 2. Fan Status Alarm: If a motor is commanded "on," and the motor status after a two minute delay indicates that the motor is off, activate status alarm. Maintain alarm until acknowledged by building operator.
- G. Input / output points list: See diagram on drawings.

2.07 SPLIT SYSTEM REFRIGERANT FAN COILS FC 1.1 AND FC 2.1

- A. General: Direct Expansion split system cooling units operating with standalone packaged controls.
 1. Space temperature controller furnished by manufacturer. Installed and wired hereunder.
- B. Space temperature setpoint: 72°F.
- C. Safety Control:
 - 1. Space temperature alarm: If the space temperature exceeds setpoint by 5°F, activate status alarm. Maintain alarm until acknowledged by building operator.

2.08 DUCT REHEAT COIL HC 2

- A. Operation Modes: Operate equipment subject to associated air handling system operating modes.
- B. Space Temperature Setpoints:
 - 1. Occupied Heating: 68°
 - 2. Unoccupied Heating: 65°
- C. Occupied Mode:
 - 1. Heating: Modulate heating control valve to maintain a discharge air temperature setpoint that is reset to maintain the space temperature setpoint.
 - a. Reheat Coil Leaving Air Temperature Setpoint: Provide control loop that modulates coil leaving air temperature setpoint to maintain the space heating temperature setpoint. Setpoint range shall be 55°F to 87°F.
 - 2. Unoccupied Mode:
 - a. Heating: Same as occupied, except modulate heating control valve to maintain unoccupied heating space temperature setpoint.
 - 1) Input / output points list: See diagram on drawings.

2.09 PANEL RADIATOR

- A. Panel Radiators:
 - 1. Operation Modes: Operate equipment subject to associated air handling system operating modes.
 - 2. Space temperature setpoints:
 - a. Occupied Heating: 68°F
 - b. Unoccupied Heating: 62°F

- 3. Occupied, Night-low Limit and Morning Warm-up Mode:
 - a. Heating: Modulate heating control valve to maintain heating space temperature setpoints.
- 4. Unoccupied Mode:
- B. Input / output points list: See diagram on drawings.
 - 1. Heating: Close heating coil control valve.

2.10 HYDRONIC UNIT HEATER

- A. Space temperature control: Start unit heater when space temperature is below 55°F. Modulate heating water control valve to maintain space temperature setpoint.
- B. Input/output points list: See diagram on drawings.

2.11 DOMESTIC WATER BOOSTER PUMP

- A. Booster pump operation is controlled by packaged controls furnished by the manufacturer. Refer to specification section 22 11 23 Domestic Water Pumps
- B. Provide a Booster Alarm: Provide booster pump alarm from contacts on packaged booster pump control panel. Maintain alarm until acknowledged by operator.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install complete control system including all components, devices, and accessories required to perform desired sequence of operation.

FACILITY NATURAL GAS PIPING AND SPECIALITES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes pipe, fittings, and specialty equipment related to natural gas service.

1.02 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.03 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
 - 1. Piping and Valves: 100 psig minimum unless otherwise indicated.
- B. Natural-Gas System Pressure within Buildings: 0.5 psig or less.

1.04 ACTION SUBMITTALS

- A. Provide submittals for products listed in the Product Table below in accordance with Section 23 05 00 – General HVAC Provisions. Submittal requirements indicated by column number designation as follows:
 - 1. Materials List
 - 2. Catalog Data
 - 3. Product Data
 - 4. Performance Data
 - 5. Wiring Diagrams
 - 6. Shop Drawings
 - 7. Installation Instructions
 - 8. Special Requirement listed herein

PRODUCT TABLE	1	2	3	4	5	6	7	8
Pipes, Tubes, and Fittings	Х							
Piping Specialties								
Manual Gas Shutoff Valves								
Pressure Regulators								

- B. Special Requirements
 - 1. Manual Gas Shutoff Valves and Motorized Gas Valves: Include pressure rating, capacity, settings, and electrical connection data of selected models.
 - 2. Pressure Regulators: Include pressure ratings and capacities.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pressure regulators to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating and protect from direct sunlight.

1.08 PRO ECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

1.09 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces.

PART 2 PRODUCTS

2.01 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 - 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
 - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 - 4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.
 - c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum O-rings, and spiral-wound metal gaskets.
 - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless-steel underground.
 - 5. Protective Coating for Piping Cast into Slab: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

2.02 PIPING SPECIALTIES

- A. Appliance Flexible Connectors:
 - 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
 - 2. Corrugated stainless-steel tubing with polymer coating.
 - 3. Operating-Pressure Rating: 0.5 psig.
 - 4. End Fittings: Zinc-coated steel.
 - 5. Threaded Ends: Comply with ASME B1.20.1.
 - 6. Maximum Length: 30 inches
- B. -Pattern Strainers:
 - 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
 - 2. End Connections: Threaded ends for NPS 2 smaller; flanged ends for NPS 2-1/2 larger.
 - 3. Strainer Screen: 40-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
 - 4. CWP Rating: 125 psig.

2.03 OINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.04 MANUAL GAS SHUTOFF VALVES

- A. General Requirements for Metallic Valves, NPS 2and Smaller: Comply with ASME B16.33.
 - 1. CWP Rating: 125 psig.
 - 2. Threaded Ends: Comply with ASME B1.20.1.
 - 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
 - 4. Listing: Listed and labeled by a Nationally Recognized Testing Laboratory acceptable to authorities having jurisdiction for valves 1-inchand smaller.
 - 5. Service Mark: Valves 1-1/4 inches to NPS 2shall have initials "WOG" permanently marked on valve body.
- B. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A. . McDonald Mfg. Co.
 - b. BrassCraft Manufacturing Co., a Masco company
 - c. Conbraco Industries, Inc.
 - 2. Body: Bronze, complying with ASTM B 584.
 - 3. Ball: Chrome-plated bronze.
 - 4. Stem: Bronze; blowout proof.
 - 5. Seats: Reinforced TFE; blowout proof.
 - 6. Packing: Threaded-body packnut design with adjustable-stem packing.
 - 7. Ends: Threaded or flanged to match piping.
 - 8. CWP Rating: 600 psig.
 - 9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 - 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.05 PRESSURE REGULATORS

- A. General Requirements:
 - 1. Single stage and suitable for natural gas.
 - 2. Steel jacket and corrosion-resistant components.
 - 3. Elevation compensator.
 - 4. End Connections: Threaded for regulators NPS 2 smaller; flanged for regulators NPS 2-1/2 larger.
- B. Appliance Pressure Regulators: Comply with ANSI Z21.18.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton
 - b. Maxitrol Company
 - 2. Body and Diaphragm Case: Die-cast aluminum.
 - 3. Springs: Zinc-plated steel; interchangeable.
 - 4. Diaphragm Plate: Zinc-plated steel.
 - 5. Seat Disc: Nitrile rubber.
 - 6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
 - 7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
 - 8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
 - 9. Maximum Inlet Pressure: 2 psig.

2.06 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, provide products by one of the following:
 - a. A. . McDonald Mfg. Co.
 - b. Watts, a Watts Water Technologies company
 - 2. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 125 psig minimum at 180°F.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.

2.07 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping according to NFPA 54 to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54 requirements for prevention of accidental ignition.

3.03 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless approved by Engineer.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Verify final equipment locations for roughing-in.

- L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- N. Extend relief vent connections for line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
 - 1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
 - 2. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
 - a. Exception: Tubing passing through partitions or walls does not require striker barriers.
 - 3. Prohibited Locations:
 - a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys, or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
 - b. Do not install natural-gas piping in solid walls or partitions.
- Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- R. Connect branch piping from top or side of horizontal piping.
- S. Install unions in pipes NPS 2 smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- T. Do not use natural-gas piping as grounding electrode.
- U. Install strainer on inlet of each line-pressure regulator and electrically operated valve.
- V. Install pressure gage downstream from each line regulator.
- W. Install sleeves for piping penetrations of walls, ceilings, and floors.
- . Install sleeve seals for piping penetrations of concrete walls and slabs.
- . Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.04 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of connector.
- B. Install regulators with maintenance access space adequate for servicing and testing.

3.05 PIPING OINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.

- 4. Apply appropriate tape or thread compound to external pipe threads.
- 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
 - 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
 - 2. Bevel plain ends of steel pipe.
 - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.
- F. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

3.06 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and supports specified in Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.

3.07 CONNECTIONS

- A. Install piping adjacent to appliances to allow service and maintenance of appliances.
- B. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- C. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.08 LABELING AND IDENTIFYING

A. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.09 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Test, inspect, and purge natural gas according to NFPA 54 and authorities having jurisdiction.
- C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.10 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 2 PSIG

- A. Aboveground piping 2-inch and smaller shall be:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.

3.11 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 2 PSIGAND LESS THAN 5 PSIG

- A. Aboveground, piping shall be:
 - 1. Steel pipe with wrought-steel fittings and welded joints.

ABOVE GROUND HYDRONIC PIPING

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes pipe, fittings, and joining methods for HVAC systems.

1.02 PERFORMANCE REQUIREMENTS

- A. All hydronic piping, equipment, fittings, and accessories shall be capable of withstanding the following maximum pressure and temperature. Exceptions would include specific items of equipment where a lower operating pressure is specified.
 - 1. Hot-Water Heating Piping:
 - a. Maximum operating pressure: 125 psig.
 - b. Maximum operating temperature: 200°F.
 - 2. Chilled-Water Piping:
 - a. Maximum operating pressure: 125 psig.
 - b. Maximum operating temperature: 200°F.
 - 3. Chilled Beam Water Piping:
 - a. Maximum operating pressure: 125 psig.
 - b. Maximum operating temperature: 70°F.
 - 4. Makeup-Water Piping:
 - a. Maximum operating pressure: 125 psig.
 - b. Maximum operating temperature: 100°F.
 - 5. Safety-Valve-Inlet and Outlet Piping:
 - a. Same as connected service pressure
 - b. Same as connected service temperature.

1.03 ACTION SUBMITTALS

- A. Provide materials list for pipe and fittings.
- B. Provide catalog data for dielectric fittings.

1.04 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code Steel."
- B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section I .
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 PRODUCTS

2.01 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Drawn-Temper Copper Tubing: ASTM B 88, Type M.
- C. DWV Copper Tubing: ASTM B 306, Type DWV.
- D. Wrought-Copper Fittings: ASME B16.22.
- E. Wrought-Copper Unions: ASME B16.22.

2.02 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications"
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications"
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications"
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.
- F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt welding.
 - 3. Facings: Raised face.
- H. Grooved Mechanical-Joint Fittings and Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Grinnell Mechanical Products
 - b. Victaulic Company
 - Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 - 3. Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings, rigid and flexible.
- I. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.03 PEX PIPING AND DISTRIBUTION MANIFOLDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Uponor
- B. PE Tubing Pipe
 - 1. ASTM F876, ASTM D3350 crosslinked polyethylene with an integral oxygen diffusion barrier.
 - 2. Maximum Pressure: 160 psi at 70°F.
 - 3. Oxygen Diffusion Barrier: oxygen diffusion through tubing no greater than 0.10 g/m3/day 104°F water temperature.
 - 4. Bending Radius: Minimum radius for cold bending of the tube not be less than six (6) times the outside diameter. Bends with a radius less than stated shall require the use of a bend support as supplied by the tubing manufacturer.
- C. Pipe Fittings:
 - 1. Fittings shall be manufactured of dezincification resistant brass and supplied by the tube manufacturer.
- D. Piping Accessories
 - 1. Pipe Supports: Galvanized steel support tray and support straps similar to Uponor Pex-A Pipe Support.

- 2. Chilled Beam Distribution Manifold
 - a. Basis of design: Uponor EP Manifold
 - b. Construction:
 - 1) Engineered plastic manifold with threaded connections.
 - 2) Threaded cap on end of supply manifold.
 - 3) Threaded cap with drain and vent on return manifold.
 - 4) Calibrated balancing valve at loop supply connections.
 - 5) Shutoff valve at loop return connections.
 - 6) Integral mounting brackets connecting supply and return manifolds.
 - c. Maximum working pressure and temperature: 145 psi at 220oF
 - d. Maximum rate flow: 21 gpm.
 - e. Configuration:
 - 1) Main supply and return: 1-1/4 inch
 - 2) Loop connections: 2-12, ³/₄ inch loops as required. Quantity as shown on Drawings.

2.04 STAINLESS STEEL TUBING

- A. Tubing: 316L stainless steel tubing.
- B. Fittings: 316 stainless steel Swagelok compression fittings.

2.05 OINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inchmaximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- E. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- F. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

PART 3 EXECUTION

3.01 PIPING APPLICATIONS

- A. Above ground hot-water heating piping, NPS 2and smaller, shall be the following:
 - 1. Type L drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 - 2. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
- B. Chilled-water piping, NPS 2and smaller, shall be either of the following:
 - 1. Type L drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 - 2. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
- C. Hot-water and chilled-water piping for chilled beam zone valve station to Chilled Beam Connection.

1. PE piping and fittings.

- D. Makeup-water piping shall be the following:
 - 1. Type L drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

- E. Condensate-Drain Piping:
 - 1. 1-1/4 and larger: Type DWV drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 - 2. 1" and smaller: Type M drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- F. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
- G. Air-Vent Piping:
 - 1. Inlet: Same as service where installed.
 - 2. Outlet: Type K annealed-temper copper tubing with soldered or flared joints.
- H. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
- I. Refrigerant Relief Piping: Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
- J. Connectors, Flexible Mechanical Couplings as specified in 23 21 16 Hydronic Piping Specialties: Flexible grooved, mechanical joint coupling and fittings.
- K. Control and Instrumentation Piping:
 - 1. 3/8-inch stainless steel tubing, unless otherwise indicated on drawings.
- L. Where piping connections, accessories, or control components are attached to piping with an operating temperature less than 60°F, penetrate the insulation vapor barrier, and do not have continuous or intermittent fluid flow.
 - 1. Provide piping and components that are non-corrosive such as stainless steel or bronze.
 - 2. Insulate and provide vapor barrier to prevent condensation. Refer to 23 07 19 HVAC Piping Insulation

3.02 VALVE APPLICATIONS

- A. Install shut off-duty valves at each branch connection to supply mains at supply connection to each piece of equipment, and where shown on drawings.
- B. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
- C. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.
- D. Install control valves according with manufacturer's instructions. Verify control valve port arrangement provides the intended function. Notify Engineer of any potential conflict between valve arrangement shown on plans and control valve installation requirements prior installing valves. Any control valves installed with incorrect connections will be re-piped to provide correct function at no expense to the Owner.
 - 1. Three-way control valve arrangement shown on plans is based on typically valve configuration. Verify three-way control valve connections prior to installing valves.

3.03 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved by Engineer.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS ³/₄ball valve, and short NPS ³/₄threaded nipple with cap, at low points in piping system mains and elsewhere as required for complete system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install unions in piping, NPS 2and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- Q. Install flanges in piping, NPS 2-1/2and larger, at final connections of equipment and elsewhere as indicated.
- R. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, inline pump, and elsewhere as indicated. Install NPS ¾nipple and ball valve in blowdown connection of strainers NPS 2and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
- S. Flexible Mechanical Coupling Connectors: Refer to 23 21 16 Hydronic Piping Specialties for installation requirements.
- T. Flush and fill systems with fluid. Coordinate and assist with installation of chemical treatment equipment and testing. Refer to 23 25 13 Water Treatment for Hydronic Systems.
- U. Provide temporary facilities required for cleaning and treatment of piping connected to existing hydronic systems:
 - 1. Provide temporary recirculation bypass assembly including:
 - a. Shutoff valves to isolates new work from existing system.
 - b. Temporary recirculation pipe connections with shutoff valves and caps.
 - c. Bypass piping with isolation valve to enable circulation in new section of piping.
 - d. Drain valves as required.
 - e. Coordinate with treatment specialist. Refer to 23 25 13 Water Treatment for Hydronic Systems.

3.04 CONNECTION BETWEEN DISSIMILAR METALS

A. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions. or provide screwed brass union or screwed brass valve where dissimilar metals meet.

3.05 HANGERS AND SUPPORTS

- A. Comply with requirements in Section 23 05 29 Hangers and Supports for HVAC Piping and Equipment for hanger, support, and anchor devices.
- B. Support vertical runs at roof and at each floor.

3.06 PIPE OINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- F. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance."
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- H. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings, except use flexible couplings where indicated to accommodate movement and for vibrations control.

3.07 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.

3.08 CHEMICAL TREATMENT

A. Install piping connections for chemical treatment equipment. Conform to 23 25 13 - Water Treatment for Closed-Loop Hydronic Systems.

3.09 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens. Repeat process until systems are clean and no debris is found in fluid or strainer screens.
 - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
 - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 - 3. Isolate expansion tanks and determine that hydronic system is full of water.
 - 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to

pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."

- After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
- 6. Prepare written report of testing.

HYDRONIC PIPING SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes special-duty valves and specialties for hydronic piping applications.

1.02 ACTION SUBMITTALS

- A. Provide submittals for products listed in the Product Table below in accordance with Section 23 05 00 - General HVAC Provisions. Submittal requirements indicated by column number designation as follows:
 - Materials List 1.
 - 2 Catalog Data
 - Product Data 3.
 - 4. Performance Data
 - 5. Wiring Diagrams
 - Shop Drawings 6.
 - 7. Installation Instructions
 - Special Requirement listed herein. 8.

PRODUCT TABLE	1	2	3	4	5	6	7	8
Hydronic Specialty Valves								
Balancing Devices								
Consolidated Fittings								
Air Control Devices								
Expansion Tanks								
Strainers								
Connectors								
Buffer Tanks								
Centrifugal Separators								

- B. Special Requirements
 - Hydronic Specialty Valves: Include flow and pressure drop curves based on 1. manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 - 2 Balancing Devices: Provide instrument schedule listing each balancing device furnished along with model number, line size, design flow, permanent pressure drop, and measurement differential pressure at design flow.
 - Flexible Spherical Expansion Joints: Provide written verification from supplier that control 3. rods have been provided where the manufacturer determines the installation exceeds the pressure requirement without control rods.

1.03 CLOSEOUT SUBMITTALS

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

1.04 QUALITY ASSURANCE

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

PART 2 PRODUCTS

2.01 HYDRONIC SPECIALTY VALVES

- A. Diaphragm-Operated Safety Valves: ASME labeled.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Bell & Gossett; a ylem brand.
 - b. Cash-Acme.
 - c. Wilkins.
 - 2. Body: Bronze or brass.
 - 3. Disc: Glass and carbon-filled PTFE.
 - 4. Seat: Brass.
 - 5. Stem Seals: EPDM O-rings.
 - 6. Diaphragm: EPT.
 - 7. Wetted, Internal Work Parts: Brass and rubber.
 - 8. Inlet Strainer: Removable without system shutdown.
 - 9. Valve Seat and Stem: Noncorrosive.
 - 10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

2.02 BALANCING DEVICES

- A. Flow Measuring Station:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong Pumps, Inc.
 - b. Tour & Andersson; available through Victaulic Company.
 - c. Macon Balancing.
 - d. Wheatley.
 - 2. Body:
 - a. 2-inch and Smaller: Bronze construction, threaded connection.
 - b. 2-1/2 inch and Larger: Cast-iron, flanged connection.
 - 3. Disc: Bronze
 - 4. Seat: Teflon or resin.
 - 5. Pressure Gage Connections: Integral quick connection test ports located upstream and downstream of valve seat for portable differential pressure meter.
 - 6. Handle Style: Hand wheel with vernier valve position scale and hidden memory stops.
 - 7. CWP Rating: Minimum 125 psig.
 - 8. Maximum Operating Temperature: 250°F.
 - 9. Size: Line size unless device pressure drop does not conform to the following requirements then provide nearest conforming size.
 - a. Full open pressure drop shall not exceed 3 feet water column at design flow.
 - b. Minimum position (0.5 turn) pressure drop shall not be less than 3 feet water column at design flow.
 - 10. Accessories: Preformed insulation jacket, ASTM 1784.
- B. Venturi Flow Meter:
 - 1. Acceptable Manufacturer: Armstrong, Tour Anderson, or approved.
 - 2. Venturi flow measuring device with built-in sensing taps, nipples, shut-off valves, quick connect couplings, and identification tag showing size, design, flow rate, and pressure difference. One-piece cadmium plated, cast-iron steel, flanged ends.
 - 3. Size In accordance with manufacturers' recommendations. Permanent pressure drop shall not exceed 3 feet water column.

2.03 CONSOLIDATED FITTINGS

- A. Acceptable Manufacturers:
 - 1. Griswold Controls

- 2. Hays Fluid Controls
- 3. IMI Flow Design
- 4. NuTech Hydronic Specialty Products
- 5. Pro Hydronic Specialties
- B. Hydronic Coil Arrangement, 2-way:
 - 1. Supply Fitting: Fitting assembly consisting of a ball valve, wye strainer, pressure/temperature tap, and union.
 - 2. Return Fitting. Fitting assembly consisting of a ball valve, venturi with two pressure/temperature taps arranged to measure water flow rate, and union.
- C. Hydronic Coil Arrangement, 3-Way:
 - 1. Supply Fitting: Fitting assembly consisting of a ball valve, wye strainer, pressure/temperature tap, and union.
 - 2. Return Control Valve Inlet Fitting: Pressure/temperature tap and union.
 - 3. Return Control Valve Outlet Fitting. Fitting assembly consisting of a ball valve, venturi with two pressure/temperature taps arranged to measure water flow rate, and union.
- D. Chilled Beam Zone Station Arrangement:
 - 1. Supply Fitting: Fitting assembly consisting of a ball valve, pressure/temperature tap, and union.
 - 2. Return Fitting. Fitting assembly consisting of a ball valve, venturi with two pressure/temperature taps arranged to measure water flow rate, and union.
- E. Components:
 - 1. Ball Valve: Brass body, chrome-plated or stainless-steel ball, Teflon seals, full port, 400 psig working pressure. Adjustable memory stops.
 - 2. Wye Strainer: Cast brass construction, 20 mesh stainless steel screen.
 - 3. Pressure/Temperature Taps: 1/4-inch NPT, solid brass, 1/8-inch probe diameter. Nordel seal for maximum 275°F service. Cap with gasket.
 - 4. Venturi: One-piece, non-ferrous bronze/brass venturi. High/low signal, /- 3% accuracy full scale overflow. Flow ranges from 0.2 gpm to 40 gpm.
- F. Accessories:
 - 1. Coil Connection Hose Kit: Flame retardant, EPDM core, Stainless steel braided hose. Provide for coil connection applications. Not required for chilled beam zone stations.
 - a. Length: ¹/₂ inch to ³/₄ inch diameter: 18 inches
 - 1) 1 inch to 1-1/2-inch diameter: 24 inches
 - 2) 2-inch diameter: 36 inches.

2.04 AIR CONTROL DEVICES

- A. Manual Air Vents:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett; a ylem brand.
 - d. Nexus Valve, Inc.
 - 2. Body: Bronze.
 - 3. Internal Parts: Nonferrous.
 - 4. Operator: Screwdriver or thumbscrew.
 - 5. Inlet Connection: NPS 1/2.
 - 6. Discharge Connection: NPS 1/8.
 - 7. CWP Rating: 150 psig.
 - 8. Maximum Operating Temperature: 225F.
- B. Automatic Air Vents:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.

- b. Bell & Gossett; a ylem brand.
- c. Spirotherm, Inc.
- d. Taco
- 2. Body: Bronze or cast iron.
- 3. Internal Parts: Nonferrous.
- 4. Operator: Noncorrosive metal float.
- 5. Inlet Connection: NPS 1/2.
- 6. Discharge Connection: NPS 1/4.
- 7. CWP Rating: 150 psig.
- 8. Maximum Operating Temperature: 240°F.
- C. Coalescing Air Separators
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Spirotherm
 - b. Taco
 - c. Wessels
 - 2. Basis of Design: Spirotherm, Spirovent Series VSR or VHR.
 - 3. Tank: Fabricated steel tank; ASME constructed and stamped for 150-psig working pressure and 270°F maximum operating temperature.
 - 4. Coalescing Medium: Copper or stainless steel.
 - 5. Air Removal: Venting chamber to prevent system contaminants from harming float and venting valve operation. Integral full port float actuated brass venting mechanism at the top of the venting chamber. Valved side tap to flush floating dirt or liquids and for quick bleeding of large amounts of air during system fill or refill.
 - 6. Inline Inlet and Outlet Connections: Threaded for NPS 2and smaller; Class 150 flanged connections for NPS 2-1/2 and larger.
 - 7. Blowdown Connection: Threaded to the bottom of the separator.
 - 8. Size: As scheduled on Drawings.

2.05 EXPANSION TANKS

- A. Bladder-Type Expansion Tanks:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Bell & Gossett; a ylem brand.
 - c. Taco
 - d. Wessels
 - Tank: Vertical welded steel, rated for 125-psig working pressure and 375°F maximum operating temperature. Factory test after taps are fabricated and supports installed. Labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1. Galvanized or epoxy coated.
 - 3. Bladder: Butyl rubber. Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
 - 4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.
 - 5. Capacity: As scheduled on drawings.

2.06 STRAINERS

- A. -Pattern Strainers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong.
 - b. Mueller Steam Specialty.
 - c. Spirax Sarco,
 - d. Watts.
 - 2. Body: Bolted cover and threaded bottom blowoff outlet connection.
 - a. Steel Piping System: ASTM A 126, Class B, cast iron.

- b. Copper Piping Systems: Bronze
- 3. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
- 4. Screen:
 - a. Free area of strainer element no less than four times the pipe cross sectional area.
 - b. Material
 - 1) Closed, chemically treated hydronic systems: Stainless-steel.
 - 2) Open or non-chemically treated hydronic systems: Brass
 - c. Size
 - 1) 2-inch and Smaller: 20 mesh
 - 2) 2-1/2 inch to 4-inch: 1/16-inch perforations
 - 3) 5-inch and Larger: 1/8-inch perforations.
- 5. CWP Rating: 125 psig.

2.07 CONNECTORS

- A. Flexible Mechanical Couplings: See to 23 21 13 Above Ground Hydronic Piping, Grooved Mechanical-Joint Fittings and Couplings.
- B. Flexible Stainless Steel or Copper/Bronze Hose Connectors
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - 2. Basis of Design:
 - a. 2-inch and Smaller: Mason Industries MN or CPS Series
 - b. 2-1/2 inch and Larger: Mason Industries FFL or CPS Series
 - 3. Construction:
 - a. Steel Piping Systems: Stainless steel braid and carbon steel fittings.
 - b. Copper Piping Systems: Braided bronze hose with copper ends.
 - 4. Minimum Face to Face Length:
 - a. 2-inch and smaller, 24 inches
 - b. 2-1/2 inch and larger, 36 inches.
 - 5. Connection
 - a. Steel
 - 1) 2-inch and Smaller: Male nipple.
 - 2) 2-1/2 inch and Larger: Flanged hoses with one fixed and one floating raised face carbon steel plate flange
 - b. Copper: Sweat connection

2.08 BUFFER TANKS

- A. Acceptable Manufacturer: Taco, Cemline Corporation, or approved.
- B. General: Carbon steel tank. ASME code constructed and stamped for 125 psi maximum pressure. Registered with the National Board of Boiler and Pressure Valve Inspectors. Tanks larger than 42-inches in diameter furnished with a 12-inch x 16-inch manhole.
- C. Accessories:
 - 1. Air vent.
 - 2. Insulated jacket for field installation.
 - 3. Thermometer.
- D. Size and capacity: As scheduled on drawings

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install equipment in accordance with manufacturer's recommendations.
- B. Pressure Reducing Valve: Locate in piping where shown on Drawings. Provide strainer upstream of pressure reducing valve and union on each side. Provide isolation valves and bypass piping with bypass valve. Provide downstream pressure gauge.

- C. Safety Relief Valve: Install where shown on drawings. Pipe to nearest drain. Provide pressure relief setting shown on Drawings.
- D. Balancing Devices:
 - Install in piping where shown on Drawings. Install with minimum lengths of straight 1. upstream and downstream pipe without valves or fittings in accordance with manufacturer's recommendations. Piping in straight upstream and downstream sections to be same size as balancing device connection.
 - Install so temperature and pressure probes can easily be inserted and removed. 2.
- E. Consolidated Fittings: Install so temperature probe and pressure gauge probe can easily be inserted and removed with no obstruction.
- F. Air Vents
 - Install automatic air vents and associated drain piping to floor drain or floor sink at the 1. following locations.
 - a. Air separator vent connection.
 - b. High points in mechanical rooms.
 - C. Top of each floor piping risers.
 - 2. Install manual air vents at all other high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
 - Provide isolation valve at each air vent. 3.
- G. Air Separator
 - Provide suitable support for separator. Do not support from adjacent piping. 1.
 - Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 2. percent upward slope toward tank.
 - 3. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.
- H. Expansion Tanks
 - Install expansion tanks on the floor. Vent and purge air from hydronic system and ensure 1. that tank is properly charged with air to suit system Project requirements.
- I. -Pattern Strainers
 - Locate where shown on drawings and ahead of reducing valves, automatic control valves, 1. and pumps.
 - 2. Arrange for easy access.
 - Provide ball valve with hose end connection on blowoff outlet of hydronic system strainers 3. two inches and larger.
 - Provide globe valve on blowoff outlet of steam system strainers. 4.
 - Provide pressure gauges on strainers 4-inch and larger. Pipe to strainer inlet and outlet. 5. Provide ball valve at each connection.
- J. Connectors:
 - 1. Install with no misalignment of piping and equipment connections.
 - 2. For flexible mechanical joints, provide minimum of three flexible mechanical couplings between last branch tee fitting to the equipment and the equipment connection.
 - Couplings may connection pipe to pipe, pipe to pipe fitting, or pipe to valve or other a. in-line piping accessory.
 - Coupling shall be spaced with minimum 12 inches between coupling and one b. coupling shall be installed in pipe segment that is not parallel with the other two such as on either side of a 90-degree elbow. Installation of all three coupling in series in one pipe segment is not acceptable.
- K. Buffer Tanks
 - Field install factory-furnished insulation package. 1.

3.02 APPLICATION

A. Consolidated fittings: Provide consolidated fittings sized as listed below regardless of pipe size shown on drawings. Where pipes size listed on drawings is different than listed provide fittings to accommodate changes in pipe size. Sized fittings based on the scheduled equipment flow rates as follows:

- 1. ¹/₂ inch: 0.5-0.5 gpm
- 2. ³/₄ inch: 0.5-3.0 gpm
- 3. 1 inch: 3.0-6.5 gpm
- 4. 1-1/4 inch: 6.5-11.0
- 5. 1-1/2 inch: 11.0-17.0
- 6. 2 inch: 17.0-40 gpm
- B. Connectors: Provide where flexible pipe connections are shown on drawings or as otherwise specified to accommodate piping expansion, vibration control, or seismic movement.
 - 1. Piping 2-inch and below: Flexible Stainless Steel or Copper/Bronze Hose Connectors
 - Provide connectors for all piping to accommodate seismic differential motion. See 23 05 48 - Vibration and Seismic Controls for HVAC, "Accommodation of Differential Seismic Motion"
 - 3. Provide connectors at equipment connections for all equipment that has vibration isolation supports.

3.03 AD USTMENT

- A. Pressure Reducing Valve: Adjust make-up water pressure setpoint to value shown on Drawings or as directed by Engineer.
- B. Compression Expansion Tank: Adjust tank charge volume in accordance with manufacturer recommendations.
- C. Bladder Expansion Tank: Adjust tank charge pressure to the system make-up pressure setpoint plus 2 psig. Adjust for elevation differences between the expansion tank and make-up pressure regulator.
- D. Centrifugal Separator: Adjust purge frequency and duration for project conditions.

HYDRONIC PUMPS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. In-line centrifugal pumps

1.02 DEFINITIONS

- A. Buna-N: Nitrile rubber.
- B. EPT: Ethylene propylene terpolymer.

1.03 QUALITY ASSURANCE

- A. Pump and motor combination shall operate at specified system fluid temperatures without vapor binding or cavitation and are non-overloading in parallel or individual operation.
- B. Pumps shall conform to ANSI/HI 9.6.1-1997 standards for Centrifugal and Vertical Pumps for NPSH Margin.
- C. Pump impeller diameter shall not exceed 90% of maximum impeller diameter.
- D. If equipment is approved which has different flow or pressure drop requirements than scheduled, contractor shall select new pumps with capacity and pressure capabilities adjusted to maintain scheduled pump efficiency and requirements. Select pumps so that the head-capacity curve slopes up to maximum pressure at shut-off. Contractor will provide all additional or larger electrical components required by an approved pump having greater horsepower than scheduled.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of pump. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.
- B. Shop Drawings: For each pump.
 - 1. Show pump layout and connections.
 - 2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
 - 3. Include diagrams for power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.06 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Mechanical Seals: One mechanical seal(s) for each pump.

PART 2 PRODUCTS

2.01 IN LINE CENTRIFUGAL PUMPS

- A. Close-coupled, In-line Booster Pumps (Small In-line)
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ylem , Bell and Gossett.
 - b. PACO Pumps; Grundfos Pumps Corporation, USA.
 - c. TACO Comfort Solutions, Inc.
 - 2. Description: Factory-assembled and tested, centrifugal, close-coupled, in-line pump; designed for installation with pump and motor shafts mounted horizontally.
 - 3. Pump Construction

- a. Casing: Cast iron, rated for 125 psig working pressure.
- b. Trim: Bronze fitted.
- c. Impeller: Bronze or fiberglass composite, enclosed type.
- d. Shaft: Stainless steel or carbon steel with bronze or stainless-steel sleeves through seal chamber.
- e. Seals: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring with Buna-N bellows and gasket. Include water slinger.
- f. Bearings: Permanently lubricated ball bearings or oil lubricated bronze sleeve.
- g. Piping Connections: Flanged.
- h. Motors: Provided hereunder, see Section 23 05 13 Common Motor Requirements for HVAC Equipment.
- i. Capacity: As scheduled on Drawings.
- B. Flexible Coupling, Horizontal Mount, In-line Circulator Pumps (Medium Inline)
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. ylem-Bell and Gossett.
 - b. PACO Pumps; Grundfos Pumps Corporation, USA.
 - c. TACO Comfort Solutions, Inc.
 - 2. Description: Factory-assembled and tested, centrifugal, close-coupled, inline pump; designed for installation with pump and motor shafts mounted horizontally.
 - 3. Pump Construction:
 - a. Casing: Vertical, split case design. Cast-iron bronze fitted construction, rated for 175 psig working pressure at 225°F, suction and discharge gauge ports at nozzles and vent and drain ports. Constructed to permit complete servicing without disconnecting piping or electrical connections.
 - b. Impeller: Cast bronze, keyed to shaft, hydraulically and dynamically balanced.
 - c. Seal: Mechanical. Internally flushed assembly. **EPR EPT** Carbon face rotating against stationary silicon-carbide face.
 - d. Shaft: Solid steel shaft supported by two permanently sealed ball bearings. Nonferrous shaft sleeve to cover wetted area under sleeve.
 - e. Piping Connections: Flanged.
 - f. Coupling: Flexible. Replaceable.
 - Motors: Provided hereunder, see Section 23 05 13 Common Motor Requirements for HVAC Equipment. Motors through 1 HP resilient mount. Motors 1-1/2 HP and larger rigid mount.
 - 5. Motor Controller: Provided hereunder as scheduled, refer to Section 23 05 14 Motor Control Devices for HVAC Equipment.
 - 6. Capacity: As scheduled on Drawings
- C. Close-coupled In-line Pumps (Large In-line)
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. ylem-Bell and Gossett
 - b. PACO Pumps; Grundfos Pumps Corporation, USA.
 - c. TACO Comfort Solutions, Inc.
 - 2. Description: Factory-assembled and tested, close-coupled, inline pump designed for installation with pump and motor shafts mounted horizontally or vertically. Cast-iron stainless steel fitted construction. Rated for 175 psig working pressure at 250°F. Back pull out access allowing pump internals to be serviced without disturbing piping connections.
 - 3. Pump Construction:
 - a. Volute: Class 30 cast iron rated for 175 psig with integral cast iron flanges. Suction and discharge gauge ports at nozzles and vent and drain ports. Constructed to permit complete servicing without disconnecting piping or electrical connections. Designed with base ring matching an ANSI 125# flange for pump support.

- b. Impeller: Stainless steel impeller. Hydraulically and dynamically balanced to ANSI/HI 9.6.4.5-2000. Allowable residual imbalance to conform to ANSI grade 6.3. Keyed to the shaft and secured by stainless steel locking capscrew or nut.
- c. Seal: Internally flushed mechanical seal assembly installed in a seal chamber. Stainless steel housing, BUNA bellows and seat gasket, stainless steel spring. Carbon ceramic design with carbon face rotating against stationary ceramic face.
- d. Shaft: Solid alloy steel shaft integral to motor. Non-ferrous shaft sleeve shall completely cover the wetted area under the seal.
- e. Piping Connections: Flanged.
- f. Bearings: Heavy duty greased ball bearings.
- 4. Motors: Provided hereunder, see Section 23 05 13 Common Motor Requirements for HVAC Equipment. Provided with heavy duty grease lubricated ball bearings to offset the additional loads associated with a close coupled design.
- 5. Motor Controller: Provided hereunder as scheduled, refer to Section 23 05 14 Motor Control Devices for HVAC Equipment.
- 6. Capacity: As scheduled on Drawings
- D. Variable Flow In-line Pumps (Variable Flow In-line)
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ylem-Bell and Gossett.
 - b. Grundfos
 - c. TACO Comfort Solutions, Inc.
 - 2. Configuration: Pump, motor, and variable speed drive shall be an integrated unit and factory assembled.
 - 3. Casing: Cast iron
 - 4. Casing Rings: Stainless steel
 - 5. O-Ring: EPDM
 - 6. Trim: Stainless steel.
 - 7. Impeller: Stainless steel or composite, enclosed type.
 - 8. Shaft: Stainless steel
 - 9. Maximum working pressure: 175 psig
 - 10. Media Temperature: 14°F to 200°F continuous duty.
 - 11. Motor: 4-pole, permanent magnet synchronous.
 - 12. Variable Frequency Drive:
 - a. Integral mounted on pump.
 - b. Operator Interface
 - 1) Minimum 2.4" color display
 - 2) Menu navigation buttons
 - 3) LEDs pump status indication
 - c. Differential Pressure Sensor: Integral to pump housing.
 - d. Input/Output:
 - 1) Analog Input: One analog input configurable for either 4-20mA or 0-10VDC signal configurable for external temperature or pressure sensor, or setpoint adjustment.
 - 2) Digital Inputs:
 - a) Start/Stop
 - b) Minimum Speed Command
 - c) Maximum Speed Command
 - 3) Digital Output: Two outputs configurable for alarm or operating indication.
 - e. Network Communications: Bacnet MS/TP
 - f. Control Functions:
 - 1) Automatic Flow Limiting: Adjustable maximum flow setpoint that the pump shall not exceed. The pump shall operate per selected control mode but will limit speed to not exceed the user specified flow limit
 - 2) Proportional Pressure Setpoint Adjustment: Pump head delivered shall reduce from a manual setpoint linearly with a decrease in system flow.

- 3) Constant Pressure: Pump will maintain a constant head pressure.
- 4) Constant Speed: Pump operates at a constant speed. Pump speed adjustable between maximum and minimum.
- 5) Constant Temperature: Pump maintains a constant media temperature flowing through the pump.
- 6) Constant Differential Temperature: Pump adjusts speed to maintain a constant temperature drop between the flow pipe in which the pump is installed, and a user installed temperature sensor.
- 13. Capacity: As scheduled on Drawings.
- 14. Accessories
 - a. Casing Insulation: Custom fitting closed cell insulation cover.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PUMP INSTALLATION

- A. Install pumps to allow access for periodic maintenance including removing motors, impellers, couplings, and accessories.
- B. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- C. In-line Pump:
 - 1. Install in-line pumps with continuous-thread hanger rods and of size required to support weight of in-line pumps.
 - 2. Comply with requirements for seismic-restraint devices specified in Section 23 05 48 Vibration and Seismic Controls for HVAC.
 - 3. Comply with requirements for hangers and supports specified in Section 23 05 29 Hangers and Supports for HVAC Piping and Equipment.

3.03 ALIGNMENT

- A. Align pumps as recommended by pump and coupling manufacturer recommendations and Hydronics Institute standards.
- B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.
- C. After alignment is correct, tighten foundation bolts evenly but not too firmly. For base mounted pumps greater than 20 HP, completely fill baseplate with non-shrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.
- D. Record field adjustments and include in the O & M manual.

3.04 CONNECTIONS

- A. Where installing piping adjacent to pump, allow space for service and maintenance.
- B. Connect piping to pumps. Install valves that are same size as piping. Install reducers or increasers as required at pump connections.
- C. Provide pump trim as detailed on drawings.
- D. Provide pressure gauge. Connect gauge to pump suction and discharge casing gauge taps. Provide ball valve at each connection.

E. Install check valve and gate or ball valve on each condensate pump unit discharge.

3.05 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Check piping connections for tightness.
 - 3. Clean strainers on suction piping.
 - 4. Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.
 - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - c. Verify that pump is rotating in the correct direction.
 - 5. Prime pump by opening suction valves and closing drains and prepare pump for operation.
 - 6. Start motor.
 - 7. Open discharge valve slowly.

3.06 DEMONSTRATION

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

REFRIGERANT PIPING AND SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Refrigerant pipes and fittings.
 - 2. Refrigerant piping valves.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping.

1.03 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to 2010 ASME Boiler and Pressure Vessel Code: Section I, "Welding and Brazing Qualifications."
- B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.06 PRODUCT STORAGE AND HANDLING

A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-134a:
 - 1. Suction Lines for Air-Conditioning Applications: 115 psig.
 - 2. Suction Lines for Heat-Pump Applications: 225 psig.
 - 3. Hot-Gas and Liquid Lines: 225 psig.

2.02 COPPER TUBE AND FITTINGS

- A. Copper Tube: Hard drawn ASTM B 280, Type ACR cleaned, dehydrated, and sealed. Annealed or hard drawn as scheduled.
- B. Long Radius 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/A5.8M.
- 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. Working Pressure Rating: Factory test at minimum 500 psig.
 - 5. Maximum Operating Temperature: 250 deg F.

2.03 VALVES AND SPECIALTIES

- A. Diaphragm Packless Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Danfoss Inc.
 - b. Heldon Products; Henry Technologies.
 - c. Parker Hannifin Corp.
 - 2. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
 - 3. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
 - 4. Operator: Rising stem and hand wheel.
 - 5. Seat: Nylon.
 - 6. End Connections: Socket, union, or flanged.
 - 7. Working Pressure Rating: 500 psig.
 - 8. Maximum Operating Temperature: 275 deg F.

PART 3 EXECUTION

3.01 PIPING

- A. Annealed ACR copper piping may be used in the following applications.
 - 1. Downstream of branch connectors in VRF systems.
 - 2. Insert description
- B. Provide hard drawn ACR copper piping to be used in all other applications.

3.02 FITTINGS

- A. Joints
 - 1. 7/8-inch and Smaller: Solder
 - 2. 1-1/8 inch and Larger: Braze

3.03 INSULATION

- A. Hard Drawn Piping: Insulate in accordance with Section 23 07 19 HVAC Piping Insulation.
- B. Annealed Piping: Where required to be insulated by Section 23 07 19 HVAC Piping Insulation pre-insulate with flexible elastomeric insulation. No less than thickness scheduled.

3.04 VALVE AND SPECIALTY APPLICATIONS

A. Provide diaphragm packless valves for isolation as shown on drawings or in accordance with the equipment manufacturer's recommendations.

3.05 PIPING INSTALLATION

- A. Install refrigerant piping according to ASHRAE 15.
- B. Install hard drawn piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- C. Install annealed copper piping with no joints between equipment connections.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Install piping adjacent to machines to allow service and maintenance.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install refrigerant piping in protective conduit where installed belowground.

- K. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- L. 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.
- M. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- N. Install sleeve seals and escutcheons. Comply with requirements for sleeve seals specified in Section 23 05 17 Sleeves, Sleeve Seals, and Escutcheons for HVAC Piping.

3.06 PIPE OINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- D. 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 BAg (cadmium-free silver) alloy for joining copper with bronze.

3.07 HANGERS AND SUPPORTS

- A. Comply with requirements for pipe hangers and supports specified in Section 23 05 29 Hangers and Supports for HVAC Piping and Equipment.
- B. Support multi-floor vertical runs at least at each floor.

3.08 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Comply with ASME B31.5, Chapter VI.
 - 2. Test refrigerant piping and specialties.
 - 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "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.
- B. Prepare test and inspection reports.

3.09 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.

WATER TREATMENT FOR HYDRONIC SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes the water treatment for the following systems:
 - 1. Closed-loop hydronic systems.

1.02 DEFINITIONS

- A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- B. TSS: Total suspended solids are solid materials, including organic and inorganic, that are suspended in the water. These solids may include silt, plankton, and industrial wastes.

1.03 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, and furnished specialties and accessories for the following products:
 - 1. Bypass feeders.
 - 2. Chemical solution tanks.
 - 3. Chemical test equipment.
 - 4. Chemical material safety data sheets.
- B. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include diagrams for power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

- A. Water Analysis Provider Qualifications: Verification of experience and capability of HVAC water-treatment service provider.
- B. Field quality-control reports.
 - 1. Utility supply water analysis.
 - 2. Construction test and inspection.
 - 3. Post construction test water testing.
- C. Other Informational Submittals:
 - 1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in "Performance Requirements" Article.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sensors, injection pumps, and controllers to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC watertreatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

1.07 MAINTENANCE SERVICE

- A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion and scale formation for hydronic piping and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion and shall include the following:
 - 1. Initial water analysis and HVAC water-treatment recommendations.
 - 2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.

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- 3. Periodic field service and consultation.
- 4. Customer report charts and log sheets.
- 5. Laboratory technical analysis.
- 6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products from one of the following: 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. ChemAcqua
 - 2. Nalco; an Ecolab company.
 - 3. US Water Service.

2.02 CLOSED LOOP HYDRONIC SYSTEMS

- A. Performance Requirements:
 - 1. Water quality for hydronic systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of hydronic equipment without creating a hazard to operating personnel or the environment.
 - 2. Base HVAC water treatment on quality of water available at Project site, hydronic system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.
 - 3. Closed hydronic systems, including hot-water heating chilled water shall have water characteristic as recommended be the chemical treatment manufacturer for the treatment chemicals provided and as follows:
 - a. pH: Maintain a value within 7.5 to 10.5 and as recommended for treatment chemicals used.
 - b. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
 - c. Soluble Copper:
 - 1) New hydronic pipe system: Maintain a maximum value of 0.20 ppm; or make-up water copper concentration, whichever is greater.
 - Expansion of existing hydronic pipe system: Maintain a maximum value of 1.0 ppm. If make-up water copper concentration is greater than 1.0, maintain a maximum value of the make-up water concentration plus 1 ppm.
 - d. Turbidity: 0-50 NTU
- B. Chemicals
 - 1. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment and that can attain water quality specified in "Performance Requirements" Article.
- C. Bypass Feeders:
 - 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. Griswold Water Systems.
 - b. J L Wingert.
 - Bypass Filter Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch fill opening in the top, and NPS 3/4 bottom inlet and top side outlet configured to accept strainer basket, bag filters, or cartridge filters. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.
 - a. Capacity: 2 gal..
 - b. Minimum Working Pressure: 175 psig at 250oF.
 - c. Accessories:
 - 1) 25-micron bag filter with stainless steel basket.

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PART 3 EXECUTION

3.01 INSTALLATION

- A. Install chemical application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.
- B. Install seismic restraints for equipment and floor-mounting accessories and anchor to building structure. Comply with requirements in Section 23 05 48 Vibration and Seismic Controls for HVAC for seismic restraints.
- C. Install water testing equipment on wall near water chemical application equipment.
- D. Install interconnecting control wiring for chemical treatment controls and sensors.
- E. Mount sensors and injectors in piping circuits.
- F. Bypass Feeders: Install in closed hydronic systems where shown on drawings, and equipped with the following:
 - 1. Install bypass feeder in a bypass circuit around circulating pumps unless otherwise indicated on Drawings.
 - 2. Install test-coupon assembly in bypass circuit around circulating pumps unless otherwise indicated on Drawings.
 - 3. Install a full-port ball isolation valves on inlet, outlet, and drain below the feeder inlet.
 - 4. Install a swing check and site glass on the inlet after the isolation valve.

3.02 EXECUTION

- A. Cleaning and Treatment of Closed-Loop Hydronic Systems: Clean and flush thoroughly prior adding chemical treatment.
 - 1. Open all valves and make adjustment as necessary to ensure water flow through all piping sections.
 - 2. Clean all strainers.
 - 3. Add cleaning compound to system and circulate for duration recommended by manufacturer.
 - 4. Flush system to force material to strainers.
 - 5. Clean strainers and repeat process until no more material is collected in strainers; and water quality is equivalent to make-up and fluid drawn from any branch line is clear when observed in a white cup.
 - 6. Add corrosion inhibitor and recirculate system for a minimum of 8 hours. If inhibitor concentration is below manufacturer's recommendations, add more inhibitor and repeat process until the required conditions are obtained.

3.03 START UP

- A. Engage a factory-authorized service representative to perform startup service for automatic feed controls.
- B. Complete installation and startup checks according to manufacturer's written instructions.
- C. Inspect field-assembled components, equipment installation, piping, controls and electrical connections for proper assembly, installation, and connection.
- D. Verify that treatment sensors are calibrated.
- E. Operate each relay. Verify output function.
- F. Test and adjust control setpoints, alarms, and safeties. Replace damaged or malfunctioning controls and equipment.
- G. Prepare test and inspection startup reports.
- H. Retain Demonstration for systems that have a Heat Trace Monitoring and Control System

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

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- B. Utility Water Analysis: Perform an analysis of utility supply water to determine quality of water available at Project site.
- C. Construction Tests and Inspections: Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
 - 2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
 - 3. Perform water analysis prior to adding water treatment chemicals. Flushing is not acceptable if soluble copper concentration exceeds 1.0 ppm greater than make-up water copper concentration. Reflush and fill system as required.
 - 4. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of hydronic systems' startup procedures.
 - 5. Do not enclose, cover, or put piping into operation until it is tested, and satisfactory test results are achieved.
 - 6. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 7. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
 - 8. 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 test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
 - 9. Repair leaks and defects with new materials and retest piping until no leaks exist.
- D. Post Construction Tests: At eight-week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to "Performance Requirements" Article.
- E. Prepare test and inspection reports.

3.05 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.
- B. Training: Provide a "how-to-use" self-contained breathing apparatus video that details exact operating procedures of equipment.

METAL DUCTWORK

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes metal ductwork, liner, and related fittings and sealants.

1.02 PERFORMANCE REQUIREMENTS

- A. Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards Metal and Flexible"
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.03 ACTION SUBMITTALS

- A. See Section 23 05 00 for general submittal requirements.
- B. Materials List:
 - 1. Shop fabricated ductwork:
- C. Catalog Data:
 - 1. Pre-manufactured Ductwork and Fittings.
 - 2. Duct Liner

1.04 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.05 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code Steel," for hangers and supports.
 - 2. AWS D1.2/D1.2M, "Structural Welding Code Aluminum," for aluminum supports.
 - 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. Comply with applicable requirements in ASHRAE 62.1, Section 5 "Systems and Equipment" and Section 7 "Construction and System Start-up."
- C. Comply with applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 "HVAC System Construction and Insulation."

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Ductwork Dimensions: Ductwork dimensions shown on drawings are internal dimensions. Adjust outer ductwork size to accommodate liner, double wall construction, or other conditions that would affect interior clear duct opening size.

2.02 SINGLE WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, ductsupport intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards -Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, ductsupport intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards -Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Sealing Requirements:
 - 1. Concealed: Seal longitudinal seams and transverse joints with liquid duct sealer or tapeand-adhesive. Flanged, gasketed joints that meet seal requirements do not require separate duct sealant application.
 - 2. Exposed: Seal non-flanged transverse joints with liquid duct sealer, specified herein, applied to male end fittings only, so that sealer is not visible when joint is assembled.

2.03 DOUBLE WALL RECTANGULAR DUCTS AND 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. McGill AirFlow LLC.
 - 2. MKT Metal Manufacturing.
 - 3. Sheet Metal Connectors, Inc.
- B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, ductsupport intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards -Metal and Flexible."
- E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, ductsupport intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards -Metal and Flexible."
- F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard." See Duct Schedule in Part 3 for liner thickness.
 - 1. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 - 2. Coat insulation with antimicrobial coating.
 - 3. Cover insulation with polyester film complying with UL 181, Class 1.
- G. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having **3 32** inch diameter perforations, with overall open area of 23 percent solid sheet steel .
- H. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Traverse 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."
- I. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-

support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

J. Sealing Requirements: Seal transverse joints in accordance with duct manufacturer recommendations.

2.04 SINGLE WALL ROUND AND FLAT OVAL DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- B. General: Round ductwork may be either shop or factory fabricated. Flat-oval ductwork shall be factory fabricated.
- C. Manufacturers: Subject to compliance with requirements, available manufacturers offering factory fabricated products that may be incorporated into the Work include, but are not limited to the following:
 - 1. McGill AirFlow LLC.
 - 2. MKT Metal Manufacturing.
 - 3. Sheet Metal Connectors, Inc.
 - 4. Spiral Manufacturing Co., Inc.
- D. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- E. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- F. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 - 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- G. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- H. Sealing Requirements:
 - 1. Concealed: Flanged, gasketed joints that meet seal requirements do not require separate duct sealant application.
 - 2. Exposed: Seal non-flanged transverse joints with liquid duct sealer, specified herein, applied to male end fittings only, so that sealer is not visible when joint is assembled.

2.05 DOUBLE WALL ROUND AND FLAT OVAL DUCTS AND 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. McGill AirFlow LLC.
 - 2. MKT Metal Manufacturing.
 - 3. Sheet Metal Connectors, Inc.

- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
 - Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - a. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
 - 2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards Metal and Flexible."
 - a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 - b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with buttwelded longitudinal seams.
 - 3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards Metal and Flexible."
- D. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard." See Duct Schedule in Part 3 for liner thickness.
 - 1. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 - 2. Coat insulation with antimicrobial coating.
 - 3. Cover insulation with polyester film complying with UL 181, Class 1.
- E. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having **3 32** inch diameter perforations, with overall open area of 23 percent solid sheet steel .
- F. Sealing Requirements: Seal transverse joints in accordance with duct manufacturer recommendations.

2.06 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: G60 G90.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- D. 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.
- E. 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.

2.07 DUCT LINER

- A. Flexible (Type I) or Rigid (Type II) Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Owens Corning.
 - 2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 - 3. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
 - a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - 2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
 - 3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
 - a. 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).
 - b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Insulation Pins and Washers:
 - 1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel, aluminum, stainless steel to match duct material; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- D. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
 - 1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Where multiple layers are required to obtain indicated thickness, provide inner perforated sheet metal duct.
 - 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
 - 3. Butt transverse joints without gaps, and coat joint with adhesive.
 - 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted edge overlapping.
 - 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.

- 6. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
- 7. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.08 SEALANT AND GASKETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries
 - 2. McGill AirSeal LLC.
 - 3. Carlisle HVAC Products
- B. 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.
- C. Two-Part Tape Sealing System:
 - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 - 2. Tape Width: 4 inches.
 - 3. Sealant: Modified styrene acrylic.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. Maximum Static-Pressure Class: 10-inch w.g., positive and negative.
 - 7. Service: Indoor and outdoor.
 - 8. Service Temperature: Minus 40 to plus 200 deg F.
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 - 10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Water-Based Joint and Seam Sealant:
 - 1. Application Method: Brush on.
 - 2. Solids Content: Minimum 65 percent.
 - 3. Shore A Hardness: Minimum 20.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. VOC: Maximum 75 g/L (less water).
 - 7. Maximum Static-Pressure Class: 10-inch w.g., 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.
- E. Solvent-Based Joint and Seam Sealant:
 - 1. Application Method: Brush on.
 - 2. Base: Synthetic rubber resin.
 - 3. Solvent: Toluene and heptane.
 - 4. Solids Content: Minimum 60 percent.
 - 5. Shore A Hardness: Minimum 60.
 - 6. Water resistant.
 - 7. Mold and mildew resistant.
 - 8. Maximum Static-Pressure Class: 10-inch w.g., positive or negative.
 - 9. Service: Indoor or outdoor.

- 10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- F. Flanged Joint Sealant: Comply with ASTM C 920.
 - 1. General: Single-component, acid-curing, silicone, elastomeric.
 - 2. Type: S.
 - 3. Grade: NS.
 - 4. Class: 25.
 - 5. Use: O.
 - 6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- G. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.09 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 EXECUTION

3.01 DUCT INSTALLATION

- A. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- B. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- C. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- D. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- E. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- F. 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.
- G. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 23 33 00 – Air Duct Accessories for fire and smoke dampers.

H. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.02 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.03 DUCT SEALING

- A. Provide Seal Class in accordance with SMACNA's "HVAC Duct Construction Standards Metal and Flexible,"
- B. Clean duct surfaces prior to applying sealant.
- C. Prior to application, verify that ducts are dry and within specified temperature limits.
- D. Open ends of completed and overnight work-in-progress shall be sealed.

3.04 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum interval 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.

3.05 SEISMIC RESTRAINT DEVICE INSTALLATION

A. See Section 23 05 48 – Vibration and Seismic Controls for HVAC.

3.06 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 23 33 00 – Air Duct Accessories.

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.07 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09.

3.08 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 representative duct sections selected by Owner's Authorize Representative from sections installed.
 - 3. Test the following systems:
 - a. Ducts with a Pressure Class Higher Than 3-Inch w.g.: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
 - 4. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 - 5. Test for leaks before applying external insulation.
 - 6. 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.
 - 7. Give seven days' advance notice for testing.
- C. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.09 START UP

A. Air Balance: Comply with requirements in Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC.

3.10 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated .
- B. Pressure Class
 - 1. Rating shall be the largest of the following conditions.
 - a. 2-inch minimum.
 - b. 120% of the fan design static pressure.
 - c. Where an automatically operated damper such as a fire and/or smoke damper or control damper can stop airflow: 100% of maximum achievable fan static pressure for fan and motor combination provided.
 - 2. Ductwork connected to fan discharge shall be rated for positive pressure.
 - 3. Ductwork connected to the fan inlet shall be rated for negative pressure.
 - 4. Ductwork interconnecting two fans shall be rated for largest of the two conditions.
- C. Seal Class
 - 1. Seal Class depending on Pressure Class in accordance with SMACNA's "HVAC Duct Construction Standards Metal and Flexible except as otherwise indicated.
- D. Leakage Class
 - 1. Leakage Class 4 Leakage Class as required to meet recommended maximum leakage percentages as tabulated in ASHRAE Handbook " HVAC Systems and Equipment -2012, Chapter 19, Table 2

- E. All ductwork single wall, except as otherwise indicated.
- F. Double wall ductwork may be manufacturer or shop fabricated in accordance with product requirements.
- G. Supply Ducts:
 - 1. Ducts Connected to Constant-Volume Air-Handling Units:
 - a. Double wall
 - b. Pressure Class: Positive 4-inch w.g.
 - 2. Ducts Connected to Fan Coil Units, :
 - a. Single Wall
 - b. Pressure Class: Positive2-inch w.g.
 - 3. Ducts Connected to Equipment Not Listed Above:
 - a. Single wall
 - b. 2-inch w.g.
- H. Return Ducts:
 - 1. Ducts Connected to Air-Handling Units:
 - a. Doublle wall.
 - b. Pressure Class: Positive or negative3-inch w.g.
 - 2. Ducts Connected to Fan Coil Units:
 - a. Pressure Class: 2-inch w.g.
 - 3. Ducts Connected to Equipment Not Listed Above:
 - a. Single wall,
 - b. Pressure Class: 2-inch w.g..
- I. Exhaust Ducts:
 - 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Positive or negative 3-inch w.g..
 - Ducts Connected to Equipment Not Listed Above:
 a. Pressure Class: Positive or negative 3-inch w.g..
 - a. Pressure Class: Positive or negative 3-inch w.
- J. Intermediate Reinforcement: Match duct material.
- K. Liner Schedule: Schedule applies to both single and double wall duct systems.
 - 1. Supply Air Ducts: Fibrous glass, Type I
 - a. Conditioned: 1 inch thick.
 - b. Unconditioned: 1-1/2 inches thick.
 - c. Outdoors: 2 inches thick.
 - 2. Return Air Ducts: Fibrous glass, Type I.
 - a. Conditioned: 1 inch thick.
 - b. Unconditioned: 1-1/2 inches thick.
 - c. Outdoors: 2 inches thick.
 - 3. Exhaust Air Ducts, upstream of heat recovery devices: Fibrous glass, Type I.
 - a. Conditioned: 1 inch thick.
 - b. Unconditioned: 1 inch thick.
 - c. Outdoors: 2 inches thick.
 - 4. Supply Fan Plenums: Fibrous glass, Type II, 2 inches thick.
 - 5. Return- and Exhaust-Fan Plenums: Fibrous glass, Type II, 2 inches thick.
- L. Double- Wall Duct Interstitial Insulation: Provide the same interstitial insulation thickness as noted in the liner schedule.
- M. Inner Duct Schedule: Provide perforated inner duct for all double wall ducts.
- N. Elbow Configuration:

1.

- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Velocity 800 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.

- b. Velocity 800 to 1500 fpm:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
- c. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
- 2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - b. Construction:
 - 1) Round Elbows, 12 Inches and Smaller in Diameter: Stamped, pleated, or standing seam, except fully welded where required for adjoining ductwork.
 - 2) Round Elbows, 14 Inches and Larger in Diameter: Standing seam or welded, except fully welded where required for adjoining ductwork.
- O. Branch Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch:
 - 1) Velocity less 1000 fpm: Conical tap or 45-degree entry.
 - 2) Velocity 1000 fpm or Higher: 45-degree entry.
 - Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards -Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity less 1000 fpm: Conical tap or 45-degree lateral.
 - b. Velocity 1000 fpm or Higher: 45-degree lateral.

AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Accessories for duct systems.

1.02 ACTION SUBMITTALS

- A. Provide submittals for products listed in the Product Table below in accordance with Section 23 05 00 – General HVAC Provisions. Submittal requirements indicated by column number designation as follows:
 - 1. Materials List
 - 2. Catalog Data
 - 3. Product Data
 - 4. Performance Data
 - 5. Wiring Diagrams
 - 6. Shop Drawings
 - 7. Installation Instructions
 - 8. Special Requirement listed herein.

PRODUCT TABLE	1	2	3	4	5	6	7	8
Manual Volume Dampers		Х						
Remote Damper Operators		Х						
Control Dampers			Х	Х				
Duct Silencers			Х	Х		х		
Turning Vanes		Х						
Flexible Connectors		Х						
Flexible Ducts		х						

1.03 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

PART 2 PRODUCTS

2.01 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.02 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and No. 4 finish for exposed ducts.
- C. 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.
- D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. 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.

2.03 MANUAL VOLUME DAMPERS

- A. Acceptable Manufacturers
 - 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. Greenheck
 - b. Nailor Industries Inc.
 - c. Pottorff.
 - d. Ruskin Company.
 - e. Trox USA Inc.
 - f. oung Regulator Company.
- B. Round/Oval Single Blade Manual Volume Dampers:
 - 1. Operating Conditions:
 - a. Maximum temperature: 180°F
 - b. Maximum differential pressure: 1-inch water column.
 - c. Maximum air velocity: 2,000 fpm.
 - d. Standard leakage rating.
 - 2. Suitable for horizontal or vertical applications.
 - 3. Frames:
 - a. One piece 20-gauge construction. Material to match connected ductwork.
 - 4. Blades:
 - a. Single blade.
 - b. 20-gauge construction. Material to match connected ductwork.
 - c. Stiffen damper blades for stability.
 - 5. Blade Axles: Minimum 3/8-inch diameter plated steel or stainless steel, except stainless steel where adjacent ductwork is aluminum or stainless steel.
 - 6. Bearings:
 - a. Oil-impregnated bronze, except stainless-steel sleeve where aluminum or stainlesssteel frames are required.
 - b. Dampers shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 7. Actuator:
 - a. Manual quadrant, except where remote damper operator is required.
 - b. Elevated platform for insulated duct mounting.
- C. Round Multiple Blade Manual Volume Dampers:
 - 1. Operating Conditions:
 - a. Maximum temperature: 180°F
 - b. Maximum differential pressure: 4-inch water column.
 - c. Maximum air velocity: 2,500 fpm.
 - d. Standard leakage rating.
 - 2. Suitable for horizontal or vertical applications.
 - 3. Frames:
 - a. One piece 10-gauge construction. Material to match connected ductwork.
 - 4. Blades:
 - a. Multiple blade.
 - b. 16-gauge construction. Material to match connected ductwork.
 - c. Stiffen damper blades for stability.
 - 5. Blade Axles: Minimum 1/2-inch diameter plated steel or stainless steel, except stainless steel where adjacent ductwork is aluminum or stainless steel.
 - 6. Bearings:
 - a. Oil-impregnated bronze, except stainless-steel sleeve where aluminum or stainlesssteel frames are required.

- b. Dampers shall have axles full length of damper blades and bearings at both ends of operating shaft.
- 7. Actuator:
 - a. Manual quadrant, except where remote damper operator is required.
 - b. Elevated platform for insulated duct mounting.
- D. Single Blade Rectangular Manual Volume Dampers:
 - 1. Operating Conditions:
 - a. Maximum temperature: 180°F
 - b. Maximum differential pressure: 1-inch water column.
 - c. Maximum air velocity: 2,000 fpm.
 - d. Standard leakage rating.
 - 2. Suitable for horizontal or vertical applications.
 - 3. Frames: Hat-shaped, welded or gusset reinforced corners. 18-gauge construction. Material to match connected ductwork.
 - 4. Blades:
 - a. Single blade.
 - b. 20-gauge construction. Material to match connected ductwork.
 - c. Stiffen damper blades for stability.
 - 5. Blade Axles: Minimum ½ inch dia. plated steel or stainless steel, except stainless steel where adjacent ductwork is aluminum or stainless steel.
 - 6. Linkages: Concealed in jamb outside or air stream.
 - 7. Bearings:
 - a. Oil-impregnated bronze, except stainless-steel sleeve where aluminum or stainlesssteel frames are required.
 - b. Dampers shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 8. Actuator:
 - a. Manual quadrant, except where remote damper operator is required.
 - b. Elevated platform for insulated duct mounting.
- E. Multiple Blade Rectangular Manual Volume Dampers:
 - 1. Operating Conditions:
 - a. Maximum temperature: 180°F
 - b. Maximum differential pressure: 4-inch water column.
 - c. Maximum air velocity: 2,000 fpm.
 - d. Standard leakage rating.
 - 2. Suitable for horizontal or vertical applications.
 - 3. Frames:
 - a. Hat-shaped, welded or reinforced corners. Material to match connected ductwork.
 - 1) Galvanized steel or stainless steel: 16-gauge.
 - 2) Aluminum: 12-gauge.
 - b. Mitered corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 4. Blades:
 - a. Opposed blade.
 - b. Rolled Formed. Material to match connected ductwork.
 - 1) Galvanized steel or stainless steel: 16-gauge.
 - 2) Aluminum: 12-gauge.
 - c. Stiffen damper blades.
 - 5. Blade Axles: Minimum ½ inch diameter plated-steel or stainless-steel, except stainlesssteel where adjacent ductwork is aluminum or stainless-steel.
 - 6. Bearings:
 - a. Oil-impregnated bronze, except stainless-steel sleeve where aluminum or stainlesssteel frames are required.
 - b. Dampers shall have axles full length of damper blades and bearings at both ends of operating shaft.

- 7. Actuator:
 - a. Manual quadrant, except where remote damper operator is required.
 - b. Elevated platform for insulated duct mounting.
- 8. Transitions: Provide factory transitions for connection to round and oval ductwork as required.

2.04 REMOTE DAMPER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck
 - 2. Pottorff.
 - 3. Ruskin
 - 4. Ventfabrics, Inc.
 - 5. oung Regulator Company.
- B. Description: Cable system designed for remote manual damper adjustment.
- C. Actuator: Damper operator: steel rack and pinion
- D. Cable: Flexible steel casing and wiring.
- E. Drive: Locking gear assembly with mounting hardware
- F. Accessories
 - 1. Wall-Box:
 - a. Mounting: Recessed.
 - b. Cover-Plate Material: Stainless-steel.

2.05 CONTROL DAMPERS

- A. High Performance Control Dampers, Standard and Insulated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Tamco
 - 2. Basis of Design:
 - a. Standard: Tamco Series 1000.
 - b. Insulated: Tamco Series 9000
 - 3. Operating Conditions: -40°F to 210°F
 - 4. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
 - a. Leakage Class: 1A at 1-inch w.g. static pressure differential.
 - 5. Frames:
 - a. U shaped 6063-T5 extruded channel, 12-gaugethickness.
 - b. Blade Width: 4-inch or 6-inch as required.
 - c. Flanged connections on both sides.
 - d. Frame Seal: Extruded silicone mechanically fastened in integral slot within frame extrusion.
 - 6. Blades:
 - a. Multiple opposed blade design, except parallel blade where otherwise indicated.
 - b. 6063-T5 extruded aluminum, 16-gaugethick dual skin air-foil with overlapping seal surface.
 - c. Blade Seal: extruded EPDM mechanically fastened in slot of overlapping blade extension.
 - d. Uninsulated, except where otherwise indicated. Insulated blades filled with expandable polyurethane foam.
 - 7. Blade Axles: 7/16-inch hexagonal control shaft; galvanized steel; blade-linkage hardware of aluminum or zinc-plated steel.
 - 8. Bearings:
 - a. Dual bearing system composed of a Celcon inner bearing, fixed around aluminum blade pivot pin, rotating within a polycarbonate outer bearing inserted in the frame.
 - 9. Actuators: Comply with 23 09 25 BAS Field Mounted Devices for HVAC

2.06 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. Elgen Manufacturing.
 - 4. SEMCO LLC.
- B. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
- C. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
 - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- D. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- E. Vane Construction: Single wall for ducts up to 18 inches wide and double wall for larger dimensions.

2.07 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. Elgen Manufacturing.
 - 4. Hardcast, Inc.
 - 5. JP Lamborn Co.
 - 6. Ventfabrics, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd.
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200°F.
- E. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 24 oz./sq. yd.
 - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F.

2.08 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. Flexmaster U.S.A., Inc.
 - 2. JP Lamborn Co.
 - 3. McGill AirFlow LLC.
 - 4. Thermaflex; a Flex-Tek Group company.
- B. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor-barrier film.
 - 1. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
 - 2. Maximum Air Velocity: 4,000 fpm.
 - 3. Temperature Range: Minus 20 to plus 175°F.
 - 4. Insulation R-Value: R4.2.

- C. Flexible Duct Elbow Support:
 - 1. Manufacturers: Titus, Flexright, Thermaflex, FlexFlow, or equal.
 - 2. Description: Radius forming brace to support flexible air ducts. UL 2043 listed.
 - 3. Material" polypropylene brace, nylon cable ties to secure duct to boards. a. Flexright.

2.09 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.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Provide low leakage control dampers as close as possible to the inlet of building exhaust fans as required by Oregon Energy Efficiency Specialty Code.
- D. Install products in locations that are accessible and that will permit adjustment and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.
- E. Manual Volume Dampers:
 - 1. Install in ductwork where shown on drawings and as required to properly balance airflow rates to values shown on Drawings. Provide damper for each air inlet and outlet.
 - 2. 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.
 - 3. Dampers must be accessible to allow inspection, adjustment, and replacement of components.
 - a. Where manual actuators are not accessible for adjustment provide remote manual cable actuator. An actuator is not accessible if it is located more than 24 inches horizontally from an access point or more than 48 inches above an access point. Coordinate location of actuator drive assembly with Architect.
 - 4. Do not compress or stretch the damper frame into the duct or opening. Damper shall move freely throughout full range of travel.
 - 5. Dampers shall be rigid and secure not producing any audible noise due to vibration of components.
 - 6. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Remote Damper Operators
 - 1. Drive units: Where operators are associated with individual inlet or outlets, locate drive unit within associated grille or diffuser where appropriate. Otherwise, provide recessed wall/ceiling recessed drive units with cover plates.
 - 2. Coordinate location of actuator drive assembly with Architect.
- G. Control Dampers
 - 1. Install dampers straight and true, level in all planes, and square in all dimensions. Install supplementary structural steel reinforcement for large multiple-section dampers if factory support alone cannot handle loading.
 - 2. Install smooth transitions, not exceeding 15 degrees, to dampers smaller than adjacent duct. Install transitions as close to damper as possible but at distance to avoid interference and impact on performance.

- 3. Unless specifically designed for vertical blade application, dampers mounted with blades horizontal.
- 4. For duct-mounted and equipment-mounted dampers installed outside of equipment with flanged connections. Install in a visible and accessible indication of damper position from outside.
- 5. Seal between damper frame and ductwork and between multiple damper sections to prevent leakage around perimeter of damper.
- 6. Provide a minimum of one damper actuator per damper section.
- 7. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.
- 8. Seal penetrations made in fire-rated and acoustically rated assemblies.
- 9. Service Access:
 - a. Dampers and actuators shall be accessible for visual inspection and service.
 - b. Install access door(s) in duct or equipment located upstream of damper to allow service personnel to hand clean any portion of damper, linkage, and actuator.
- H. Turning Vanes
 - 1. Install in mitered ductwork elbows and as shown on drawings.
 - 2. Install with leading and trailing edges parallel to entering and leaving airflow.
- I. Flexible Connectors
 - 1. Install flexible connectors to connect ducts to equipment.
 - 2. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- J. Flexible Ductwork
 - 1. Install in professional manner with straight sections without bends or sagging. Bends in flexible ductwork shall not exceed 20 degree unless supported by a Flexible Duct Elbow Support. Maximum length of 48-inchs or as detailed on Drawings.
 - 2. Connect flexible duct directly to diffusers and grilles, except where otherwise shown on drawings. Provide Flexible Duct Elbow Support at 90-degree elbow to diffuser or grille.
 - 3. Connect flexible ducts to metal ducts with tape and draw bands.
 - a. Tape inner duct liner to ductwork.
 - b. Secure inner duct liner with nylon draw strap.
 - c. Secure outer liner with nylon draw strap.
- K. Test Holes
 - 1. Install test holes at fan inlets and outlets, coil inlets and outlets, and elsewhere as indicated.

3.02 APPLICATION

- A. Manual Volume Dampers:
 - 1. Material: Volume damper construction frame and blade material shall match material of connected ductwork.
 - 2. Type:
 - a. Round/Oval Single Blade Manual Volume Dampers: All round ductwork 20-inch diameter and below.
 - b. Round Multiple Blade Manual Volume Dampers: All round ductwork greater than 20inch diameter in exposed or concealed locations.
 - c. Rectangular Single Blade Manual Volume Dampers: Rectangular ductwork where largest cross-sectional dimension is 18-inches and below.
 - d. Rectangular Multiple Blade Manual Volume Dampers:
 - 1) Round or oval ductwork greater than 20-inch diameter located in concealed locations. Provide rectangular to round transition for connecting to round ductwork.

- Rectangular or oval ductwork where largest cross-sectional dimension greater than 18-inches. Provide rectangular to oval transition for connecting to oval ductwork.
- e. Round Airflow Measurement and Balancing Dampers: Provide for the following applications:
 - 1) Insert Note Here
- B. Control Dampers
 - 1.
 - 2. Roof curb isolation dampers
 - a. Damper Type: High Performance Control Dampers, Insulated.
 - b. Damper Width: 4-inch
 - c. Blade Action: Opposed
 - d. Blade Orientation: Parallel to longest dimension.
 - 3. Air handler isolation dampers, factory installed
 - a. Damper Type: High Performance Control Dampers, Insulated.
 - b. Damper Width: 6-inch
 - c. Blade Action: Opposed
 - d. Blade Orientation: Parallel to longest dimension.
 - 4. Other applications not listed above, or as indicated on drawings
 - a. Damper Type: High Performance Control Dampers, Standard.
 - b. Damper Width: 6-inch, except where otherwise indicated on drawings or where physical spatial limitation required 4-inch blade width.
 - c. Blade Action: Opposed
 - d. Blade Orientation: Parallel to longest dimension.
 - 5. Actuators: Comply with 23 09 25 BAS Field Mounted Devices for HVAC
- C. Flexible Connectors
 - 1. Indoor system: All indoor applications, except where otherwise required.
 - 2. Outdoor system: All outdoor applications, except where otherwise required.

3.03 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 - 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 - 4. Inspect turning vanes for proper and secure installation.
 - 5. Operate remote damper operators to verify full range of movement of operator and damper prior to covering work or limiting access for inspection.
- B. Control-Damper Checkout:
 - 1. Check installed products before continuity tests, leak tests, and calibration.
 - 2. Check dampers for proper location and accessibility.
 - 3. Verify that control dampers are installed correctly for flow direction.
 - 4. Verify that proper blade alignment, either parallel or opposed, has been provided.
 - 5. Verify that damper frame attachment is properly secured and sealed.
 - 6. Verify that damper actuator and linkage attachment are secure.
 - 7. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
 - 8. Verify that damper blade travel is unobstructed.
 - 9. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.

HVAC POWER VENTILATORS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Centrifugal roof ventilators.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
 - 2. Rated capacities, operating characteristics, and furnished specialties and accessories.
 - 3. Certified fan performance curves with system operating conditions indicated.
 - 4. Certified fan sound-power ratings.
 - 5. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 6. Material thickness and finishes, including color charts.
 - 7. Prefabricated roof curbs.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.

1.03 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For HVAC power ventilators to include in normal and emergency operation, and maintenance manuals.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of unit components.
- C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.
- D. Seismic Performance: HVAC power ventilators shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. See Section 23 05 48 – Vibration and Seismic Controls for HVAC.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Component Importance Factor: 1.5.

2.02 CENTRIFUGAL VENTILATORS ROOF DOWNBLAST

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck Fan Corporation.
 - 2. Loren Cook Company.
 - 3. New ork Blower Company (The).
 - 4. PennBarry.
 - 5. Twin City Blower.
- B. Housing: Downblast; removable spun-aluminum dome or square top and outlet baffle; square,

one-piece aluminum base with venturi inlet cone.

- C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- D. Direct-Driven Fans:
 - 1. Motor: Permanently lubricated, fully modulating, variable speed, electrically commentated Comply with requirements in Section 23 05 13 Common Motor Requirements for HVAC Equipment.
 - 2. Vibration isolation: Neoprene mounting.
 - 3. Fan and motor isolated from exhaust airstream.
- E. Accessories:
 - 1. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
 - 2. Shutoff Dampers: Parallel-blade dampers mounted in curb base with electric actuator, Refer to 23 33 00 Air Duct Accessories, Control.
 - 3. Hinged curb cap with restraint cables. Allows the fan to tilt away for access to wheel and ductwork.
 - 4. Mounting Pedestal: Galvanized steel with removable access panel.
- F. Prefabricated Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch-thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base. Comply with requirements in 23 05 00 General HVAC Provisions, Roof Curbs, Bases, and Rails without integral vibration Isolation.
 - 1. Configuration: Compatible with roofing systems. Coordinate with Architectural. Manufactured to accommodate roof slope.
 - 2. Overall Height: 16 inches.
 - 3. Damper tray.
 - 4. Sound Curb: Curb with sound-absorbing insulation.
 - 5. Hinged sub-base to provide access to damper or as cleanout for grease applications.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

- A. Install power ventilators level and plumb.
- B. Equipment Mounting:
 - 1. Roof Mounted Units: Install fans on roof curbs or as otherwise detailed on drawings. Comply with requirements in 23 05 00 - General HVAC Provisions, Roof Curbs, Bases, and Rails without integral vibration Isolation.
 - 2. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
 - 3. Comply with requirements for vibration isolation and seismic-control devices specified in Section 23 05 48 Vibration and Seismic Controls for HVAC.
- C. Install units with clearances for service and maintenance.

3.02 DUCTWORK CONNECTIONS

- A. Drawings indicate general arrangement of ducts and duct accessories.
- B. Provide shutoff dampers for each exhaust outlet in accordance with Code.

3.03 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks in accordance with manufacturer's written instructions.
 - 2. Verify that shipping, blocking, and bracing are removed.
 - 3. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 4. Verify that cleaning and adjusting are complete.
 - 5. For direct-drive fans, verify proper motor rotation direction and verify fan wheel free rotation and smooth bearing operation.
 - 6. For belt-drive fans, disconnect fan drive from motor, verify proper motor rotation direction,

and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.

- 7. Adjust damper linkages for proper damper operation.
- 8. Verify lubrication for bearings and other moving parts.
- 9. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
- 10. Disable automatic temperature-control operators, energize motor and confirm proper motor rotation and unit operation, adjust fan to indicated rpm, and measure and record motor voltage and amperage.
- 11. Shut unit down and reconnect automatic temperature-control operators.
- 12. Remove and replace malfunctioning units and retest as specified above.

3.04 AD USTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Lubricate bearings.

3.05 CLEANING

A. After completing system installation and testing, adjusting, and balancing and after completing startup service, clean fans internally to remove foreign material and construction dirt and dust.

3.06 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Diffusers
 - 2. Grilles

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static pressure drop, and noise ratings.

1.03 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Size and location of initial access modules for acoustical tile.
 - 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 - 4. Duct access panels.

PART 2 PRODUCTS

2.01 COMMON REQUIREMENTS

- A. Source Quality Control
 - 1. Verification of Performance: Rate diffusers according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following, unless specifically stated otherwise:
 - 1. Anemostat Products; a Mestek company.
 - 2. Krueger.
 - 3. Nailor Industries Inc.
 - 4. Price Industries.
 - 5. Titus.

2.02 RECTANGULAR AND SQUARE CEILING DIFFUSERS

- A. Square and Rectangular Neck Louvered Diffusers SD-1
 - 1. Basis of Design: Titus TDC
 - 2. Material: Steel.
 - 3. Finish: Baked enamel, white.
 - 4. Duct Inlet: Square or rectangular, size as shown on Drawings.
 - 5. Pattern: Four-way core style, or as shown on drawings. Provide adjustable pattern controller to adjust vertical to horizontal blow pattern where shown on Drawings.
 - 6. Mounting:
 - a. Surface: Flush, Titus Type 1
 - b. Suspended Ceiling: Flush, border type and module size compatible with ceiling system.
 - c. Exposed: Flush, Titus Type 1

2.03 SUPPLY GRILLES

- A. Adjustable Blade Register SG-1
 - 1. Basis of design: Titus 300 RL/RS
 - 2. Material: Steel
 - 3. Finish: Baked enamel, white

- 4. Blade arrangement: Individually adjustable horizontal and vertical blades, front blades parallel to the long dimension. Spaced ¾ inch apart.
- 5. Core construction: Integral
- 6. Frame: 1-1/4 inch wide.
- 7. Mounting:
 - a. Surface: Countersunk screw
 - b. Suspended ceiling: Flush, border type and module size compatible with ceiling system.
 - c. Exposed: Countersunk screw.

2.04 RETURN GRILLES

- A. Fixed Blade Grille RG/EG-1
 - 1. Basis of Design: Titus 350 RL/RS
 - 2. Material: Steel.
 - 3. Finish: Baked enamel, white.
 - 4. Blade Arrangement: 35-degree blade deflection. Spaced 3/4 inch apart. Blades parallel to long dimension if installed in ceiling or horizontal position. Blades parallel to floor if installed in wall or vertical position.
 - 5. Frame: 1-1/4 inches wide.
 - 6. Mounting:
 - a. Surface: Countersunk screw.
 - b. Suspended Ceiling: Flush, border type and module size compatible with ceiling system.
 - c. Exposed: Countersunk screw.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas where diffusers are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install diffusers 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 with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.
- D. Mounted devices tight to finished surface

3.03 AD USTING

A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

PARTICULATE AIR FILTRATION

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Flat panel filters.
 - 2. Pleated panel filters.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include dimensions; operating characteristics; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.
- B. Product Test Reports: For each filter, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.03 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each filter, for tests performed by manufacturer and witnessed by a qualified testing agency a qualified testing agency .

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of filter and rack to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

- A. ASHRAE Compliance:
 - 1. Comply with applicable requirements in ASHRAE 62.1, Section 4 "Outdoor Air Quality"; Section 5 "Systems and Equipment"; and Section 7 "Construction and Startup."
 - 2. Comply with ASHRAE 52.1 for arrestance and ASHRAE 52.2 for MERV for methods of testing and rating air-filter units.
- B. Comply with NFPA 90A and NFPA 90B.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in a clean, dry place.
- B. Comply with manufacturer's written rigging and installation instructions for unloading and moving to final installed location.
- C. Handle products carefully to prevent damage, breaking, denting, and scoring. Do not install damaged products.
- D. Protect products from weather, dirt, dust, water, construction debris, and physical damage.
 - 1. Retain factory-applied coverings on equipment to protect finishes during construction and remove just prior to operating unit.
 - 2. Cover unit openings before installation to prevent dirt and dust from entering inside of units. If required to remover coverings during unit installation, reapply coverings over openings after unit installation and remove just prior to operating unit.
- E. Replace installed products damaged during construction.

PART 2 PRODUCTS

2.01 PLEATED PANEL FILTERS

- A. Description: Factory-fabricated, self-supported, extended-surface, pleated, panel-type, disposable air filters with holding frames.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. AAF/Flanders.

- b. Camfil Farr.
- B. Filter Unit Class: UL 900, Class 2.
- C. Media: Cotton and synthetic fibers coated with nonflammable adhesive.
 - 1. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. 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."
 - 3. Media shall be coated with an antimicrobial agent.
 - 4. Separators shall be bonded to the media to maintain pleat configuration.
 - 5. Welded wire grid shall be on downstream side to maintain pleat.
 - 6. Media shall be bonded to frame to prevent air bypass.
 - 7. Support members on upstream and downstream sides to maintain pleat spacing.
- D. Filter-Media Frame: Cardboard frame with perforated metal retainer Galvanized steel Aluminized steel with metal grid on outlet side and steel rod grid on inlet side, hinged, with pull and retaining handles sealed or bonded to the media.
- E. Mounting Frames: Welded galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.
- F. Capacities and Characteristics:
 - 1. Designation: F-1
 - a. Face Dimensions: As required to accommodate filter frame or housing.
 - b. Depth: 2 inch or 4 inch as required to match filter housing.
 - c. Initial Pressure Drop: 0.33-inches w.g. at 500 fpm.
 - d. Final Resistance: 1 inch-w.g. at 500 fpm.
 - e. Maximum Rated Pressure Drop: 2-inches w.g..
 - f. MERV Rating: 8 when tested according to ASHRAE 52.2.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Sizing:
 - 1. Select filter frames and housing to allow use of standard, readily available filter sizes.
 - 2. Metric size filters not acceptable.
- B. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.
- C. Install filters in position to prevent passage of unfiltered air.
- D. If permanently installed air handlers and air distribution system are used during construction, MERV 8 filtration media shall be installed at each return-air grille. Filters in air handlers used during construction shall have a minimum MERV 13 rating for systems that deliver air to occupied spaces or through air coils or heat exchangers.
- E. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.
- F. Install filter-gage, static-pressure taps upstream and downstream from filters. Install filter gages on filter banks with separate static-pressure taps upstream and downstream from filters. Mount filter gages on outside of filter housing or filter plenum in an accessible position.
- G. Coordinate filter installations with duct and air-handling-unit installations.
- H. Filters shall fit in racks without bending, distortion, or modification.

3.02 APPLICATION

A. Provide filters and racks in equipment and in terminal devices as specified and as shown on drawings.

3.03 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:1. Test for leakage of unfiltered air while system is operating.
- C. Air filter will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.04 CLEANING

A. After completing system installation and testing, adjusting, and balancing of air-handling and air-distribution systems, clean filter housings and install new filter media.

ELECTRONIC AIR CLEANERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. High efficiency filtration systems

1.02 ACTION SUBMITTALS

- A. Provide submittals for products listed in the Product Table below in accordance with Section 23 05 00 – General HVAC Provisions. Submittal requirements indicated by column number designation as follows:
 - 1. Materials List
 - 2. Catalog Data
 - 3. Product Data
 - 4. Performance Data
 - 5. Wiring Diagrams
 - 6. Shop Drawings
 - 7. Installation Instructions
 - 8. Special Requirement listed herein.

PRODUCT TABLE	1	2	3	4	5	6	7	8
High efficiency germicidal filtration system								

PART 2 PRODUCTS

2.01 HIGH EFFICIENCY GERMICIDAL FILTRATION SYSTEM

- A. Acceptable Manufacturers: Dynamic Air Quality Solutions.
- B. Designation: F-2.
- C. Filtration system consisting disposable filter element, the filter enhancement module, and the master control unit. The system shall have a minimum filtration efficiency rating of MERV 13 per ASHRAE Standard 52.2 at a face velocity of 500 FPM. CSA 22.1, UL 867 rated.
- D. Disposable Filter Elements: Initial resistance shall not exceed 0.37" w.g. at 500 FPM face velocity. UL 900 class II rated. Ultra-low-bypass disposable filter element consisting of minipleated microglass fiber filter media packs with a conductive metal grid attached to its downstream surface acting as the downstream field electrode. Enclosing frame constructed of molded polymer with an integrated fin/pile gasket. The media pack shall be mechanically and chemically bonded to the inside periphery of the enclosing frame by use of a high-density thermoset.
- E. Filter Enhancement Modules: UL94 5V rated. Filter enhancement modules composed of a precision stamped stainless-steel assembly acting as the ionization array and an assembly composed of high voltage cable held in tension by insulating polymer supports acting in its entirety as the upstream field electrode. These components shall be enclosed within an extruded polymer frame. Each filter enhancement module shall consume an average of 7 watts and a maximum of 29 watts and draw no more than 0.2A at 120VAC.
- F. Master Control Units: Master control unit contains all power and control functions necessary to properly operate filter enhancement modules. The control modules and supporting electronics shall be enclosed within a NEMA 2 enclosure. External to the enclosure shall be visual and physically accessible LED indicators of power function and power on/off switch. Power input 115V/1/60 VAC, 3A. Master Control Units shall be BAS enabled. Controller to provide dry contact alarm output.

- G. Filter Rack: Extruded aluminum, low bypass S-Rack. Filter racks shall be flat panel in configuration to enable side or downstream loading. Tracks permanently gasketed to eliminate air bypass. Where required, vertical support members shall be furnished to support horizontal members.
- H. Filter Cabinet: Modular air handler cabinet section designed for outdoor use. Unit will downturned outdoor air intake with ½-inch birdscreen, prefilter section, and electronic air cleaning filter section.
 - 1. Base rail: Galvanized steel
 - 2. Casing joints: Hermetically sealed at each corner and around entire perimeter. Unit constructed with raised seams. Top of each roof panel seam sealed with a roof cleat mechanically formed to enclose the standing seam at the roof panel to panel joint. Roof to slope from center axis to sides to preclude standing water.
 - 3. Wall, Roof, and Floor
 - a. Material: G90 galvanized steel.
 - b. Factory finish: Provide manufacturers standard finish.
 - 4. Inside casing wall
 - a. Material: G90 galvanized steel.
 - 5. Casing insulation
 - a. Materials: injected polyurethane foam insulation
 - b. Casing Panel R-value: Minimum R-13
 - c. Insulation thickness: 2-inches
 - 6. Panels
 - a. Fabrication: Formed and reinforced double wall and insulated panel of same material and thickness as casing.
 - b. Fasteners: Two or more camlock type for panel lift out operation. Arrangement shall allow panels to be opened against airflow.
 - c. Gasket: Neoprene applied around entire perimeters of panel frames.
 - d. Size: Large enough to allow unobstructed access for inspection and maintenance of electronic air filters.
 - 7. Doors
 - a. Fabrication: Formed and reinforced double wall and insulated panels of same material and thickness as casing.
 - b. Hinges: A minimum of two ball bearing hinges or stainless steel piano hinge and two wedge lever latches operable from inside and outside. Arrange doors to be opened against airflow. Provide safety latch retainers on doors so that doors do not open uncontrollably.
 - c. Gasket: Neoprene, applied around entire perimeters of panel frames.
 - d. Size: Large enough to allow for unobstructed access for periodic replacement of filters.
- I. Size and Capacity: As scheduled or as furnished by equipment manufacturer.
- J. Basis of Design: Dynamic Air V8

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturers recommendations.
- B. Ensure that adequate access is provided for easy filter replacement.
- C. Ensure that the filters are installed properly within their frames to prevent air from bypassing the filter media.

3.02 EXTRA FILTERS

A. Provide one (1) additional set of filters to Owner for each application.

3.03 MANUFACTURER'S FIELD SERVICES

A. High Efficiency Germicidal Filtration Systems

- 1. Manufacturer's trained technician shall provide the following services:
 - a. Verify correct installation of filter, control wiring, and power wiring.
 - b. Verify proper operation.
 - c. Provide final adjustments to meet the specified performance requirements.
 - d. Provide one start-up report to engineer no more than two weeks after start-up.
 - e. The manufacturer shall provide 4 hours of training by a factory service technician. Start-up shall not take the place of training. Train Owner on equipment components, functions, general operation, maintenance, and sequence of operations. Operator training documentation shall be submitted to the Authorized Owner's Representative and the Engineer.

BOILER STACKS, CONDENSING BOILER

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section specifies flue gas exhaust duct system from boiler, furnace, or other fuel burning appliance outlet to stack outlet to the atmosphere. Section includes transitions, expansion joints, rain caps, and accessories.

1.02 ACTION SUBMITTALS

- A. Provide submittals for products listed in the Product Table below in accordance with Section 23 05 00 – General HVAC Provisions. Submittal requirements indicated by column number designation as follows:
 - 1. Materials List
 - 2. Catalog Data
 - 3. Product Data
 - 4. Performance Data
 - 5. Wiring Diagrams
 - 6. Shop Drawings
 - 7. Installation Instructions
 - 8. Special Requirement listed herein.

PRODUCT TABLE	1	2	3	4	5	6	7	8
Double wall boiler stack								

- B. Special Requirements:
 - 1. Provide scale drawings showing nominal dimensions and weight of the systems.
 - 2. Boiler and burner manufacturer shall review complete system from boiler flue gas outlet to stack outlet to atmosphere and notify Owner of any changes required to meet performance requirements. Note altitude of site.
 - 3. Provide performance calculations showing boiler outlet draft pressure at minimum and maximum boiler firing rates.

PART 2 PRODUCTS

2.01 DOUBLE WALL BOILER STACKS

- A. Acceptable Manufacturer: Selkirk Metalbestos, Metal-Fab Inc., Ampco. Similar to: Metalbestos SAF-T Vent.
- B. General: Pre-engineered, factory-fabricated, double wall systems consisting of factory-built standard sections, connected in the field with joining system designed by system manufacturer.
 - 1. Vent Pipe and Fittings: Circular cross section, air space between walls. Designed to be pressure and vacuum-tight, no deformation, at the service conditions specified.
 - 2. Inner Wall Material: Stainless steel, AL 29-AC.
 - 3. Outer Wall Material: 430 stainless steel
 - 4. Air Space between Inner and Outer Walls: One-inch minimum
 - 5. Bands for Joining Sections: Same material as wall being joined
 - 6. Stack Outlet: Exit cone
 - 7. Fuel: Natural gas, LP gas
 - 8. Listing: NFPA 211, UL-1738
- C. Rated Service Condition:
 - 1. Maximum Continuous Operating Temperature: 500°F
 - 2. Pressure Rating: 15 inches positive, neutral, or negative

- 3. Clearance to combustibles: UL-listed for 1-inch vertical clearance to combustible materials and 2-inch horizontal clearance to combustible materials.
- D. Accessories:
 - 1. Expansion sections: Provide as recommended by manufacturer.
 - 2. Roof Jack: Non-ventilated supporting fitting compatible with roof construction and pitch.
 - 3. Stack Supports: Support assemblies, guy section, and guy tensioners provided by chimney manufacturer.

PART 3 EXECUTION

3.01 PREPARATION

A. Dimensions: Fabrication of chimney system to be made from field measurements and as-built equipment shop drawings.

3.02 INSTALLATION

- A. Install as shown on Drawings and in accordance with manufacturer's recommendations.
- B. Use manufacturer-supplied installation assemblies except structural steel framework as detailed on drawings.
- C. Slope horizontal sections toward boilers at slope of I/4" drop to I'-0" horizontal run.

CONDENSING BOILERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Packaged condensing type heating water boiler

1.02 DESIGN REQUIREMENTS

- A. Equipment performance calculated for actual project elevation.
- B. Clearance to Combustibles: UL Listing for zero side wall clearance.

1.03 ACTION SUBMITTALS

- A. Provide submittals for products listed in the Product Table below in accordance with Section 23 05 00 – General HVAC Provisions. Submittal requirements indicated by column number designation as follows:
 - 1. Materials List
 - 2. Catalog Data
 - 3. Product Data
 - 4. Performance Data
 - 5. Wiring Diagrams
 - 6. Shop Drawings
 - 7. Installation Instructions
 - 8. Special Requirement listed herein.

PRODUCT TABLE	1	2	3	4	5	6	7	8
Condensing hot water boiler								

- B. Special Requirements:
 - 1. Boiler and burner manufacturer shall review complete flue system from boiler flue gas outlet to stack outlet to atmosphere and provide written approval of stack design with comments identifying any changes required to meet performance requirements and necessary measurement ports or other components needed for boiler start-up, tuning, and operation.
 - 2. Wiring Diagrams: Provide complete wiring diagrams indicating all wiring completed under this section including operating controls, burner controls, safety controls, and field wiring for all items of equipment and the system as a whole. Differentiate between manufacturer and field installed wiring.
 - 3. Provide factory test reports. Indicate and interpret test results to verify conformance with performance requirements before shipping.

1.04 QUALITY ASSURANCE

A. Coordinate the entire assembly of boiler, boiler trim, burner, fuel trains including gas pressure regulators, burner control and flame safeguard, control system, emergency shutdown switch, breeching, and stacks.

1.05 PRO ECT CONDITIONS

- A. Fuels to be Fired, Main Burner: Natural gas
- B. Pilot Fuels: Natural gas
- C. Natural Gas: Furnished by local utility. Higher Heating Value is reported as 1,050 Btu per cubic foot at base pressure and temperature.

- D. Combustion Air: 80° F, 0.013 lbs. moisture per lb. dry air
- E. Maximum supply water temperature: 200°F
- F. Maximum heating water system pressure: 125 psig

1.06 ADDITIONAL WARRANTY

A. 20-year, non-prorated warranty for damage due to thermal shock.

PART 2 PRODUCTS

2.01 CONDENSING HOT WATER BOILER

- A. Acceptable Manufacturers: Lochinvar or approved.
- B. General: Gas-fired, condensing fire tube design with positive discharge pressure. Selfsupporting, baffle free, helical fire tube heat exchanger, warranted to withstand thermal shock. UL listed.
- C. Heat Exchanger: Pressure vessel constructed of SA53 carbon steel, with a 0.25" thick wall and 0.50" thick upper head. The boiler shall be capable of handling return water temperatures down to 40°F without any failure due to thermal shock or fireside condensation.
 - 1. Inspection openings: In accordance with ASME Section IV pressure vessel code.
 - 2. Rated Pressure: ASME stamped for a working pressure not less than 150 psig.
- D. Exhaust Manifold: Corrosion resistant porcelainized cast iron. The exhaust manifold shall have a gravity drain for removal of the condensation with collecting reservoir.
- E. Burner: Cast stainless steel burner head. All burner materials exposed to the combustion zone shall be of stainless-steel construction. 15:1 turndown.
- F. Fuel Train: UL listed, ASME CSD-1 approved.
- G. Boiler Controls: Provide the following:
 - 1. Boiler discharge temperature control
 - 2. Burner flame safeguard system
 - 3. Remote discharge temperature reset from Building Management System
 - 4. Electric probe-type low water cutoff and dual over-temperature protection including manual reset in accordance with ASME CSD-1.
 - 5. Remote fault alarm contacts and sensor failure detection
 - 6. Message annunciation
 - 7. Fault diagnostic display
- H. Safety Valves: Provide one or more on each boiler. Conform to ASME Boiler and Pressure Vessel Code, Section IV.
- I. Schedule: As shown on Drawings
- J. Condensate Neutralizer:
 - 1. Rectangular PVC container with limestone media in-line with condensate drain, sized for peak boiler condensate flow. Removable water-tight cover or opening suitable for media change-out, without removing neutralizer from piping.
 - 2. Provide additional limestone media, sufficient for two future change-outs.

PART 3 EXECUTION

3.01 BOILER INSTALLATION

- A. Install as shown on Drawings and in accordance with manufacturer's recommendations.
- B. Access: Arrange all equipment and piping to allow access for normal service without disassembly of equipment or piping.

C. Provide boiler condensate drain from exhaust manifold connection to floor drain. Size in accordance with manufacturer's recommendation.

3.02 BOILER START UP

- A. Manufacturer's certified representative to provide the following services:
 - 1. Inspect boiler after installation to ensure boiler installation is in accordance with manufacturer's recommendation.
 - 2. Supervise initial start-up.
 - 3. Provide minimum 4 hours of training, including operation and maintenance. Coordinate schedule with Owner.
 - 4. Adjust burner to obtain specified performance and combustion efficiency. Perform efficiency tests. Submit test report to Engineer within seven days of startup.
 - 5. Test boiler safety control devices. Complete and submit ASME CSD-1 form CG-500 to engineer within seven days of startup.
- B. Perform initial boil-out of boiler according to manufacturer's recommendations. Provide chemicals, temporary piping, and facilities necessary for work as required.

SCROLL WATER CHILLERS, AIR COOLED

PART 1 GENERAL

1.01 SUMMARY

A. Section includes packaged, air-cooled, electric-motor-driven, scroll water chillers.

1.02 DEFINITIONS

- A. BAS: Building automation system.
- B. COP: Coefficient of performance. The ratio of the rate of heat removal to the rate of energy input using consistent units for any given set of rating conditions.
- C. DDC: Direct digital control.
- D. EER: Energy-efficiency ratio. The ratio of the cooling capacity given in Btu/h to the total power input given in watts at any given set of rating conditions.
- E. IPLV: Integrated part-load value. A single-number part-load efficiency figure of merit for a single chiller calculated per the method defined by AHRI 550/590 and referenced to AHRI standard rating conditions.
- F. kW/Ton: The ratio of total power input of the chiller in kilowatts to the net refrigerating capacity in tons at any given set of rating conditions.
- G. NPLV: Nonstandard part-load value. A single number part-load efficiency figure of merit for a single chiller calculated per the method defined by AHRI 550/590 and intended for operating conditions other than the AHRI standard rating conditions.
- H. SCCR: Short-circuit current rating.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include refrigerant, rated capacities, operating characteristics, and furnished specialties and accessories.
 - 2. Performance at AHRI standard conditions and at conditions indicated.
 - 3. Performance at AHRI standard unloading conditions.
 - 4. Minimum evaporator flow rate.
 - 5. Refrigerant capacity of water chiller.
 - 6. Oil capacity of water chiller.
 - 7. Fluid capacity of evaporator.
 - 8. Characteristics of safety relief valves.
 - 9. Force and moment capacity of each piping connection.
- B. Shop Drawings: Complete set of manufacturer's prints of water chiller assemblies, control panels, sections and elevations, and unit isolation. Include the following:
 - 1. Assembled unit dimensions.
 - 2. Weight and load distribution.
 - 3. Required clearances for maintenance and operation.
 - 4. Size and location of piping and wiring connections.
 - 5. Diagrams for power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

- A. Installation instructions.
- B. Source quality-control reports.
- C. Startup service reports.
- D. Sample Warranty: For special warranty.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each water chiller to include in emergency, operation, and maintenance manuals.
- B. Spare Parts List: Recommended spare parts list with quantity for each.
- C. Touchup Paint Description: Detailed description of paint used in application of finish coat to allow for procurement of a matching paint.
- D. Instructional Videos: Including those that are prerecorded and those that are recorded during training.

1.06 QUALITY ASSURANCE

A. AHRI Certification: Certify chiller according to AHRI 590 certification program.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Ship water chillers from the factory fully charged with refrigerant and filled with oil.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Site Altitude: Chiller shall be suitable for altitude at which installed without affecting performance indicated. Make adjustments to affected chiller components to account for site altitude.
- B. AHRI Rating: Rate water chiller performance according to requirements in AHRI 550/590.
- C. ASHRAE Compliance: ASHRAE 15 for safety code for mechanical refrigeration.
- D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 "Heating, Ventilating, and Air-Conditioning."
- E. ASME Compliance: Fabricate and stamp water chiller heat exchangers to comply with ASME Boiler and Pressure Vessel Code.
- F. Comply with NFPA 70.
- G. Comply with requirements of UL 1995, "Heating and Cooling Equipment," and include label by a qualified testing agency showing compliance.
- H. Outdoor Installations:
 - 1. Chiller shall be suitable for outdoor installation indicated. Provide adequate weather protection to ensure reliable service life over a 25-year period with minimal degradation due to exposure to outdoor ambient conditions.
 - 2. Chillers equipped to provide safe and stable operation while achieving performance indicated when operating at extreme outdoor temperatures encountered by the installation. Review historical weather database and provide equipment that can operate at extreme outdoor temperatures recorded over past 30-year period.

2.02 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Daikin
 - 2. Carrier Global Corporation.
 - 3. Trane.
 - 4. ORK; brand of Johnson Controls International plc, Building Solutions North America.

2.03 MANUFACTURED UNITS

- A. Description: Factory-assembled and run-tested water chiller complete with compressor(s), compressor motors and motor controllers, evaporator, condenser with fans, electrical power, controls, and indicated accessories.
- B. Sound-reduction package shall have the following:
 - 1. Acoustic enclosure around compressors.
 - 2. Reduced-speed fans with acoustic treatment.
3. Designed to reduce sound level without affecting performance.

2.04 CABINET

- A. Base: Galvanized-steel base extending the perimeter of water chiller. Secure frame, compressors, and evaporator to base to provide a single-piece unit.
- B. Frame: Rigid galvanized-steel frame secured to base and designed to support cabinet, condenser, control panel, and other chiller components not directly supported from base.
- C. Casing: Galvanized steel.
- D. Finish: Coat base, frame, and casing with a corrosion-resistant coating capable of withstanding a 500-hour salt-spray test according to ASTM B117.

2.05 COMPRESSOR DRIVE ASSEMBLIES

- A. Compressors:
 - 1. Description: Positive-displacement direct drive with hermetically sealed casing.
 - 2. Each compressor provided with suction and discharge service valves, crankcase oil heater, and suction strainer.
 - a. For multiple compressor assemblies, it is acceptable to isolate each compressor assembly in lieu of each compressor.
 - 3. Operating Speed: Nominal 3600 rpm for 60-Hz applications.
 - 4. Oil Lubrication System: Automatic pump with strainer, sight glass, filling connection, filter with magnetic plug or removable magnet in sump, and initial oil charge.
 - a. Manufacturer's other standard methods of providing positive lubrication are acceptable in lieu of an automatic pump.
 - 5. Vibration Isolation: Mount individual compressors on vibration isolators.
 - a. For multiple compressor assemblies, it is acceptable to isolate each compressor assembly in lieu of each compressor.
- B. Compressor Motors:
 - 1. Hermetically sealed and cooled by refrigerant suction gas.
 - 2. High-torque, two-pole induction type with inherent thermal-overload protection on each phase.
- C. Compressor Motor Controllers:
 - 1. Across the Line: NEMA ICS 2, Class A, full voltage, non-reversing.

2.06 REFRIGERATION

- A. Refrigerant: R-410A. Classified as Safety Group A1 according to ASHRAE 34.
- B. Refrigerant Compatibility: Parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.
- C. Refrigerant Circuit: Each circuit shall include an electronic-expansion valve, refrigerant charging connections, a hot-gas muffler, compressor suction and discharge shutoff valves, a liquid-line shutoff valve, a replaceable-core filter-dryer, a sight glass with moisture indicator, a liquid-line solenoid valve, and an insulated suction line.
- D. Refrigerant Isolation: Factory install positive shutoff isolation valves in the compressor discharge line and the refrigerant liquid-line to allow the isolation and storage of the refrigerant charge in the chiller condenser.
 - 1. For multiple compressor assemblies, it is acceptable to isolate each compressor assembly in each circuit in lieu of each compressor.
- E. Pressure Relief Device:
 - 1. Comply with requirements in ASHRAE 15, ASHRAE 147, and applicable portions of ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - 2. Select and configure pressure relief devices to protect against corrosion and inadvertent release of refrigerant.
 - 3. ASME-rated, spring-loaded, pressure relief valve; single- or multiple-reseating type. Pressure relief valve(s) shall be provided for each heat exchanger.

2.07 EVAPORATOR

- A. Brazed Plate:
 - 1. Direct-expansion, single-pass, brazed-plate design.
 - 2. Type 304or316stainless-steel construction.
 - 3. Code Compliance: Tested according to ASME Boiler and Pressure Vessel Code.
 - 4. Fluid Nozzles: Terminate with mechanical-coupling end connections for connection to field piping.
 - 5. Inlet Strainer: Factory-furnished, 20or40-mesh strainer for field installation in supply piping to evaporator. Manufacturer has option to factory install strainer.
- B. Flow Switch: Factory-furnished thermal-type flow switch wired to chiller operating controls.
- C. Heater: Factory-installed and -wired electric heater with integral controls designed to protect the evaporator to minus 20 deg F.

2.08 AIR COOLED CONDENSER

- A. Coil(s) with integral subcooling on each circuit.
- B. Copper Tube with Plate Fin Coils:
 - 1. Construct coils of copper tubes mechanically bonded to aluminum fins.
 - 2. Coating: None.
- C. Aluminum Microchannel Coils:
 - 1. Series of flat tubes containing a series of multiple, parallel-flow microchannels layered between refrigerant header manifolds.
 - 2. Single- or multiple-pass arrangement.
 - 3. Construct fins, tubes, and header manifolds of aluminum alloy treated with a corrosion-resistant coating.
- D. Fans: Direct-drive propeller type with statically and dynamically balanced fan blades, arranged for vertical air discharge.
- E. Fan Motors: TENV or TEAO enclosure, with sealed and permanently lubricated bearings, and having built-in overcurrent- and thermal-overload protection.
 - 1. Overcurrent- and thermal-overload protection not integral to motor is acceptable if provided with chiller electrical power package.
- F. Fan Guards: Removable steel safety guards with corrosion-resistant coating.

2.09 INSULATION

- A. Closed-cell, flexible, elastomeric thermal insulation complying with ASTM C534/C534M, Type I for tubular materials and Type II for sheet materials.
 - 1. Thickness: 3/4 inch.
- B. Adhesive: As recommended by insulation manufacturer.
- C. Factory-applied insulation over all cold surfaces of chiller capable of forming condensation. Components shall include, but not be limited to, evaporator, evaporator water boxes including nozzles, refrigerant suction pipe from evaporator to compressor, cold surfaces of compressor, refrigerant-cooled motor, and auxiliary piping.
 - 1. Apply adhesive to 100 percent of insulation contact surface.
 - 2. Before insulating steel surfaces, prepare surfaces for paint, and prime and paint as indicated for other painted components. Do not insulate unpainted steel surfaces.
 - 3. Seal seams and joints to provide a vapor barrier.
 - 4. After adhesive has fully cured, paint exposed surfaces of insulation to match other painted parts.
 - 5. Manufacturer has option to factory or field insulate chiller components to reduce potential for damage during installation.
 - 6. Field-Applied Insulation:
 - a. Components that are not factory insulated shall be field insulated to comply with requirements indicated.

- b. Manufacturer shall be responsible for chiller insulation whether factory or field installed to ensure that manufacturer is the single point of responsibility for chillers.
- c. Manufacturer's factory-authorized service representative shall instruct and supervise installation of field-applied insulation.
- d. After field-applied insulation is complete, paint insulation to match factory-applied finish.

2.10 ELECTRICAL

- A. Factory installed and wired, and functionally tested at factory before shipment.
- B. Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to water chiller.
- C. House in a unit-mounted, NEMA 250, Type 3R, 4, or 4x enclosure with hinged access door with lock and key or padlock and key.
- D. Wiring shall be numbered and color-coded to match wiring diagram.
- E. Factory wiring shall be located outside of an enclosure in a metal raceway. Terminal connections shall be made with not more than a 24-inch length of liquidtight conduit.
- F. Field power interface shall be to circuit breaker. Minimum SCCR according to UL 508 shall be as required by electrical power distribution system, but not less than 65,000 A.
- G. Each motor shall have branch power circuit and controls with one of the following disconnecting means having SCCR to match main disconnecting means:
 - 1. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
 - 2. NEMA KS 1, heavy-duty, non-fusible switch.
 - 3. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
- H. Each motor shall have overcurrent protection.
- I. Overload relay sized according to UL 1995, or an integral component of water chiller control microprocessor.
- J. Phase-Failure and Undervoltage: Solid-state sensing with adjustable settings.
- K. Power Factor Correction: Capacitors to correct power factor to 0.90 at full load.
- L. Controls Transformer: Unit-mounted transformer with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.
- M. Control Relays: Auxiliary and adjustable time-delay relays, or an integral to water chiller microprocessor.
- N. Service Receptacle:
 - 1. Unit-mounted, 120-V GFCI duplex receptacle.
 - 2. Power receptacle from chiller internal electrical power wiring.
- O. Indicate the following for water chiller electrical power supply:
 - 1. Current, phase to phase, for all three phases.
 - 2. Voltage, phase to phase and phase to neutral for all three phases.
 - 3. Three-phase real power (kilowatts).
 - 4. Three-phase reactive power (kilovolt amperes reactive).
 - 5. Power factor.
 - 6. Running log of total power versus time (kilowatt hours).
 - 7. Fault log, with time and date of each.

2.11 CONTROLS

- A. Factory installed and wired, and functionally tested at factory before shipment.
- B. Standalone, microprocessor based, with all memory stored in nonvolatile memory so that reprogramming is not required on loss of electrical power.

- C. Enclosure: Share enclosure with electrical power devices or provide a separate enclosure of matching construction.
- D. Operator Interface: Keypad or pressure-sensitive touch screen. Multiple-character, digital display. Display the following:
 - 1. Date and time.
 - 2. Operating or alarm status.
 - 3. Operating hours.
 - 4. Outside-air temperature if required for chilled-water reset.
 - 5. Temperature and pressure of operating set points.
 - 6. Chilled-water entering and leaving temperatures.
 - 7. Refrigerant pressures in evaporator and condenser.
 - 8. Saturation temperature in evaporator and condenser.
 - 9. No cooling load condition.
 - 10. Elapsed time meter (compressor run status).
 - 11. Pump status.
 - 12. Antirecycling timer status.
 - 13. Percent of maximum motor amperage.
 - 14. Current-limit set point.
 - 15. Number of compressor starts.
 - 16. Alarm history with retention of operational data before unit shutdown.
 - 17. Superheat.
- E. Control Functions:
 - 1. Manual or automatic startup and shutdown time schedule.
 - 2. Capacity control based on evaporator leaving-fluid temperature.
 - 3. Capacity control compensated by rate of change of evaporator entering-fluid temperature.
 - 4. Chilled-water entering and leaving temperatures, control set points, and motor load limit. Chilled-water leaving temperature shall be reset based on space temperature.
 - 5. Current limit and demand limit.
 - 6. Condenser-water temperature.
 - 7. External water chiller emergency stop.
 - 8. Antirecycling timer.
 - 9. Automatic lead-lag switching.
- F. Manual-Reset Safety Controls: The following conditions shall shut down water chiller and require manual reset:
 - 1. Low evaporator pressure or high condenser pressure.
 - 2. Low chilled-water temperature.
 - 3. Refrigerant high pressure.
 - 4. High or low oil pressure.
 - 5. High oil temperature.
 - 6. Loss of chilled-water flow.
 - 7. Loss of condenser-water flow.
 - 8. Control device failure.
- G. DDC System Interface: Factory-install hardware and software to enable system to monitor, control, and display chiller status and alarms.
 - 1. Hardwired I/O Points:
 - a. Monitoring: On/off status, common trouble alarm .
 - b. Control: On/off operation, chilled-water discharge temperature set-point adjustment.
- H. Factory-installed wiring outside of enclosures shall be in NFPA 70-complaint raceway. Make terminal connections with liquidtight flexible metallic conduit.

2.12 ACCESSORIES

A. Factory-furnished neoprene isolators for field installation.

2.13 CAPACITIES AND CHARACTERISTICS

A. Capacity and performance as scheduled on drawings.

- B. Low Ambient Operation: Chiller designed for operation to 0 deg F.
- C. High Ambient Operation: Chiller designed for operation to 115 deg F.

2.14 MATERIALS

- A. Steel:
 - 1. ASTM A36/A36M for carbon structural steel.
 - 2. ASTM A568/A568M for steel sheet.
- B. Stainless Steel:
 - 1. Manufacturer's standard grade for casing.
 - Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.
- C. Galvanized Steel: ASTM A653/A653M.
- D. Aluminum: ASTM B209.

2.15 SOURCE QUALITY CONTROL

- A. Perform functional test of water chillers before shipping.
- B. Factory performance test water chillers, before shipping, according to AHRI 550/590.
 - 1. Test the following conditions:
 - a. Design conditions indicated.
 - b. AHRI 550/590 part-load points.
- C. Factory test and inspect evaporator and water-cooled condenser according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1. Stamp with ASME label.
- D. For water chillers located outdoors, rate sound power level according to AHRI 370 procedure.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Before water chiller installation, examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, controls, and electrical connections to verify actual locations, sizes, and other conditions affecting water chiller performance, maintenance, and operations.
 - 1. Water chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping, controls, and electrical connections.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 WATER CHILLER INSTALLATION

- A. Coordinate sizes and locations of base support with actual equipment provided.
- B. Install water chillers on support structure indicated.
- C. Equipment Mounting:
 - 1. Comply with requirements for vibration isolation and seismic-control devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."
- D. Maintain manufacturer's recommended clearances for service and maintenance.
- E. Maintain clearances required by governing code.
- F. Chiller manufacturer's factory-trained service personnel shall charge water chiller with refrigerant if not factory charged and fill with oil if not factory installed.
- G. Install separate devices furnished by manufacturer and not factory installed.
 - 1. Chillers shipped in multiple major assemblies shall be field assembled by chiller manufacturer's factory-trained service personnel.

3.03 PIPING CONNECTIONS

- A. Where installing piping adjacent to chillers, allow space for service and maintenance.
- B. Evaporator Fluid Connections:
 - 1. Connect to evaporator inlet with shutoff valve, flexible connector, thermometer, and plugged tee with pressure gage and as detailed on drawings.

- 2. Connect to evaporator outlet with shutoff valve, flexible connector, flow switch, thermometer, plugged tee with pressure gage, and drain connection with valve.
- C. Connect each drain connection with a drain valve, full size of drain connection. Connect drain pipe to drain valve with union and extend drain pipe to terminate over floor drain.
- D. Connect each chiller vent connection with a manual vent, full size of vent connection.

3.04 ELECTRICAL POWER CONNECTIONS

A. Provide nameplate for each electrical connection indicating electrical equipment designation and circuit number feeding connection. Nameplate shall be laminated phenolic layers of black with engraved white letters at least 1/2 inch high. Locate nameplate where easily visible.

3.05 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.
- C. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
 - 1. Verify that refrigerant charge is sufficient and water chiller has been leak tested.
 - 2. Verify that pumps are installed and functional.
 - 3. Verify that thermometers and gages are installed.
 - 4. Operate water chiller for run-in period.
 - 5. Check bearing lubrication and oil levels.
 - 6. Verify that refrigerant pressure relief device for chillers installed indoors is vented outside.
 - 7. Verify proper motor rotation.
 - 8. Verify static deflection of vibration isolators, including deflection during water chiller startup and shutdown.
 - 9. Verify and record performance of water chiller protection devices.
 - 10. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
- D. Visually inspect chiller for damage before starting. Repair or replace damaged components, including insulation. Do not start chiller until damage that is detrimental to operation has been corrected.
- E. Prepare a written startup report that records results of tests and inspections.

3.06 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water chillers.
 - 1. Instructor shall be factory trained and certified.
 - 2. Provide not less than eight hours of training.
 - 3. Train personnel in operation and maintenance and to obtain maximum efficiency in plant operation.
 - 4. Provide instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
 - 5. Obtain Owner sign-off that training is complete.
 - 6. Owner training shall be held at Project site.

SECTION 23 7200

AIR TO AIR HEAT RECOVERY EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Packaged indoor heat recovery ventilator

1.02 DESIGN REQUIREMENTS

A. Equipment performance calculated using project site elevation.

1.03 ACTION SUBMITTALS

- A. Provide submittals for products listed in the Product Table below in accordance with Section 23 05 00 – General HVAC Provisions. Submittal requirements indicated by column number designation as follows:
 - 1. Materials List
 - 2. Catalog Data
 - 3. Product Data
 - 4. Performance Data
 - 5. Wiring Diagrams
 - 6. Shop Drawings
 - 7. Installation Instructions
 - 8. Special Requirement listed herein.

PRODUCT TABLE	1	2	3	4	5	6	7	8
Packaged indoor heat recovery ventilator								

1.04 QUALITY ASSURANCE

- A. Constructed in accordance with CSA C22.2 and UL 1812 and shall carry the ETL label of approval.
- B. Insulation shall comply with NFPA 90A for flame spread and smoke generation.
- C. Airflow data shall comply with AMCA test method.
- D. Units run tested before shipment.

PART 2 PRODUCTS

2.01 PACKAGED OUTDOOR HEAT RECOVERY VENTILATOR

- A. Acceptable Manufacturers: RenewAire or approved equal.
- B. Basis of Design: RenewAire DN-5RT Energy Recovery Ventilator.
- C. General: Packaged outdoor heat recovery ventilator with supply fan, exhaust fan, flat plate exchanger, cooling coil, heating coil, and single point electrical connection. Configuration as shown on Drawings.
- D. Cabinet:
 - 1. G90 galvanized, 20-gauge steel with lapped corners and zinc plated fasteners.
 - 2. Case walls and doors insulated with 2-inch polyurethane foam. Minimum R value of 13.
 - 3. 24-gauge galvanized steel liner.
 - 4. Galvanized steel rails for mounting on roof curb.
 - 5. Standing seam roof sloped to drain water.
 - 6. Access Doors: Provided for blowers, heat exchanger, and filters.
- E. Outdoor intake hood: Downturned and louvered intake hood with ½-inch bird screen.
- F. Condensate drain pan
 - 1. Material: Stainless Steel

- 2. Rectangular with 1% slope in at least two planes to drain condensate from cooling coil towards ¾-inch drain connection. Minimum 2-inches deep.
- G. Supply and Exhaust Fans: Direct drive plenum type fan with ECM motors.
- H. Motors: Premium efficiency, EISA compliant for energy efficiency.
- I. Heat Exchanger: Phenolic resin, flat plate exchanger. Water vapor transfer by molecular transport. Airstreams shall not mix. Laminar flow at all operating conditions. Exchanger shall perform without condensing or frosting when outside temperature is greater than -10oF. Condensate drains not required.
- J. Heating and Cooling Coils: Provided hereunder, refer to Section 23 82 16 Air Coils.
- K. Controls
 - 1. General: Factory installed microprocessor controls, switches, power supplies, wiring, and other miscellaneous devices for all control functions.
 - 2. Operator interface: Keypad or pressure sensitive touch screen. Multiple-character, digital display. Display the following:
 - a. Control operational mode: Cooling/Off/Heating
 - b. Status Data
 - 1) Damper position
 - 2) Filter status
 - 3) Fan status
 - 4) Cooling
 - 5) Heating
 - 6) Fan alarm
 - 7) General alarm
 - c. Discharge air temperature
 - d. Discharge pressure
 - e. Outdoor airflow
 - f. Exhaust airflow
 - g. Outdoor dry bulb temperature
 - h. Outdoor humidity
 - i. Exhaust temperature
 - j. Supply temperature
 - k. Return air temperature
 - I. Return air humidity
 - 3. Control interface: Factory installed hardwire and software to enable BAS to monitor, control, and display unit status and alarms.
- L. Dampers: Factory installed outside air and exhaust dampers with electric actuators.
- M. Filters: Provide filter racks and filters upstream of flat plate exchanger on supply and exhaust sides. F-1, 2-inch. See Section 23 41 00 Particulate Air Filtration.
 - 1. Provide factory installed filter monitors for each airstream.
 - 2. Electronic air cleaners for outside air intake: F-1 & F-2. Provide hereunder, refer to Section 23 43 00 Electronic Air Cleaners
- N. Electrical:
 - 1. Single point electrical connection.
 - 2. Unit electrical box to include factory installed, non-fused disconnect switch and a 24VAC, Class II transformer/relay package.
 - 3. Outside and exhaust dampers factory wired to open when unit is enabled.
 - 4. Service receptacle: 120VA GFCI service outlet mounted to exterior of unit.
- O. Accessories
 - 1. Roof Curb: Roof Curb kit 16" height shall provide support for the air handler on the building roof and provide a weather protected area for terminating and securing the roof membrane. The roof curb kit shall be manufactured and shipped separately from the air handler.

2. Smoke detector: Duct mounted smoke detector shipped loose for installation in the field and connected to the terminal block for the unit.

PART 3 EXECUTION

3.01 INSPECTION

- A. Install fan level and plumb as recommended by manufacturer.
- B. Install fans with clearances for service and maintenance.
- C. Make final connections with flexible connectors.
- D. Ground equipment in accordance with manufacturer's recommendations. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values
- E. Install belt guards.

3.02 FIELD QUALITY CONTROL

- A. Equipment Start-up Checks
 - 1. Verify shipping, blocking, and bracing has been removed.
 - 2. Verify that unit is secure on mountings and supporting devices, and that connection to ducts and electrical components are complete.
 - 3. Verify that proper thermal overload protection is installed in motors, starters, and disconnect switches. Adjust overload settings for fan motor rated load amperage.
 - 4. Verify that cleaning and adjusting is complete.
 - 5. Verify that fan wheel rotates freely and the bearing operation is smooth.
 - 6. Verify lubrication of bearing and other rotating parts.
- B. Start-up Procedures:
 - 1. Energize fan motors.
 - 2. Measure and record motor voltage and amperage.

SECTION 23 7605

AIR COOLED CONDENSING UNIT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air-cooled, scroll compressor, condensing unit

1.02 ACTION SUBMITTALS

- A. Provide submittals for products listed in the Product Table below in accordance with Section 23 05 00 – General HVAC Provisions. Submittal requirements indicated by column number designation as follows:
 - Materials List 1.
 - 2 Catalog Data
 - Product Data 3.
 - 4. Performance Data
 - 5. Wiring Diagrams
 - 6. Shop Drawings
 - 7. Installation Instructions
 - 8. Special Requirement listed herein.

PRODUCT	T TABLE	1	2	3	4	5	6	7	8
Condensir	g unit								

1.03 QUALITY ASSURANCE

- A. Comply with applicable Standards and/or Codes of ETL, cETL, NEC, ASHRAE Standard 90.1, and OSHA as adopted by the state.
- Electrically operated components UL listed and labeled. B.
- Safety certified by ETL, and the nameplate shall carry the agency label. C.

PART 2 PRODUCTS

2.01 CONDENSING UNIT

- A. Acceptable Manufacturer: Trane or approved.
- Description: Factory assembled, air-cooled scroll compressor condensing units. Each unit shall R consist of an air-cooled condenser section and isolated control compartment containing hermetic scroll compressors, control system, suction and liquid connection valves, and all components necessary for safe and controlled unit operation when connected to the specified low side equipment.
- C. Construction:
 - Completely factory assembled, piped, and wired and shipped in one section. 1.
 - Specifically designed for outdoor application. 2.
 - Paint finish capable of withstanding at least 2500 hours, with no visible corrosive effects, 3. when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.
 - 4. Condenser coil mechanically protected from physical damage by painted galvanized steel louvers covering the full area of the coil.
- D. Compressor:
 - 1. Provide two R-410A compressors. First compressor shall be variable capacity scroll type. Second compressor shall be two-stage scroll type.
 - Inherent thermal overload protection and mounted on rubber vibration isolators. 2.
 - Each compressor furnished with crankcase heater. 3.

- E. Condenser
 - 1. Coils: seamless copper tubes mechanically bonded into plate type aluminum fins. The fins shall have full drawn collars to completely cover the tubes. A sub-cooling section shall be an integral part of the main condenser coil.
 - 2. Condenser fan(s): Propeller type arranged for vertical air discharge and driven by a direct drive fan motor. The fan discharge area shall be equipped with a heavy-gauge fan guard.
 - 3. Coils: Seamless copper tubes mechanically bonded into plate type aluminum fins. The fins shall have full drawn collars to completely cover the tubes. A sub-cooling section shall be an integral part of the main condenser coil.
 - 4. Fan Motor(s): weather protected, single-phase, direct drive, 1100 rpm, open drip-proof type.
- F. Refrigerant Circuits:
 - 1. Designed for R-410A refrigerant. Condensing unit furnished with liquid line filter driers and service valves for liquid and suction connections. The finished field installed refrigerant circuit furnished by the contractor shall include the low side cooling components, refrigerant, thermal expansion valve, liquid line, insulated hot gas line, and insulated suction line.
 - 2. Condensing unit shall be provided with adjustable condenser head pressure control to allow cooling operation down to 35°F.
- G. Control System:
 - 1. Centrally located weatherproof control panel shall be isolated from condenser coil airflow, and shall contain the field power connection points, control terminal block and control system.
 - 2. Control circuit transformer and wiring shall provide 24V control voltage from the line voltage provided to the unit.
 - 3. Power and starting components shall include fan motor contactors, 5 minute off time delay relay(s) for the compressor(s), inherent fan motor overload protection and unit power terminal blocks for connection to remote disconnect switch. Safety and operating controls shall include a manually reset high pressure switch and an automatic reset low pressure switch. Barrier panels shall be furnished to protect against accidental contact with line voltage when accessing the control system.
 - 4. Unit terminal block shall provide for Building Automation System start stop of each compressor stage and modulation of the variable capacity scroll compressor using a 0 to 5V signal.
- H. Wiring Diagram:
 - 1. Color-coded and marked wiring diagrams shall be provided in both "point-to-point" and "ladder" to match the color and markings of the unit wiring.
 - 2. Diagrams laminated in plastic and permanently fixed to the control compartment door.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's requirements, shop drawings, and contract documents.
- B. Adjust and level unit on supports.
- C. Install refrigerant piping in accordance with Drawings.
- D. Evacuate the system and charge with refrigerant in accordance with standard practice.
- E. Coordinate electrical installation with electrical contractor.
- F. Coordinate controls with control contractor.
- G. Provide all appurtenances required to insure a fully operation and functionally system.

3.02 STARTUP

- A. Check and assure proper system charge of refrigerant and oil.
- B. Provide testing and start-up of system.
- C. Provide 4 hours of instruction to Owner in unit operation and maintenance.

SECTION 23 8216

AIR COILS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Hydronic heating and cooling air coils.
 - 2. Refrigerant air coils.

1.02 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 each air coil.
 - 2. Include rated capacities and operating characteristics including:
 - a. Tube water velocity for hydronic coils
 - b. Pressure drops for each air coil.

1.03 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which coil location and ceiling-mounted access panels are shown and coordinated with each other.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air coils to include in operation and maintenance manuals.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Selection Criteria:
 - 1. Hydronic Coil Tube Velocity: Coils shall be selected with appropriate tube water velocity to ensure acceptable performance at low load conditions. Coils tube water velocity at rated operating conditions shall be equal to or greater than the following, except where limited by minimum tube diameter or maximum coil pressure drop:
 - a. Heating water coils: 2.5 feet per second.
 - b. Chilled water coils: 3.0 feet per second.
 - 2. Hydronic Coil Water Pressure Drop: Coils shall be selected for a maximum water pressure drop as follows, except pressure drop is scheduled on drawings:
 - a. Duct mounted reheat coils: 5 feet water column.
 - b. Active chilled beams: 10 feet water column.
 - c. Fan coil unit heating coils: 10 feet water column.
 - d. Air handler heating coils: 12 feet water column.
 - e. Chilled water cooling coils: 15 feet water column.

2.02 HYDRONIC COILS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Aerofin.
 - 2. Carrier Corporation; a unit of United Technologies Corp.
 - 3. Colmac Coil Manufacturing, Inc.
 - 4. Daikin Industries
 - 5. Greenheck Fan Corporation.
 - 6. Heatcraft Worldwide Refrigeration.
 - 7. Trane.
- B. Performance Ratings: Tested and rated according to AHRI 410 and ASHRAE 33.
- C. Minimum Working-Pressure/Temperature Ratings: 200 psig, 325°F.
- D. Source Quality Control: Factory tested to 300 psig.

- E. Tubes: ASTM B 743 copper, minimum thickness 0.025 inch for tubes 5/8" and larger, 0.020inch for 1/2-inch tubes. Minimum diameter, 0.5 inch.
- F. Fins: Aluminum Copper, minimum 0.0075 inch thick.
- G. Headers:
 - 1. Copper runout piping or for open loop systems with untreated water sources such as city potable water or well systems: Seamless copper tube with brazed joints, prime coated or cast iron with cleaning plugs and drain and air vent tappings.
 - 2. Steel runout piping in closed loop systems: Steel with brazed joints, prime coated or cast iron with drain and air vent tappings.
- H. Hot-Water Coil Capacities and Characteristics:
 - 1. Coil Face Dimensions: As scheduled on Drawings or as required to achieve scheduled performance.
 - 2. Minimum Fin Spacing: 0.083 inch.
 - 3. Tube Diameter: As required to achieve scheduled performance.
 - 4. Number of Rows: As required to achieve scheduled performance, two row minimum.
 - 5. Frames: Galvanized-steel channel frame, minimum 0.064 inch thick
 - 6. Mounting: Flanged.
 - 7. Performance: As scheduled on Drawings.
- I. Chilled-Water Coil Capacities and Characteristics:
 - 1. Coil Face Dimensions: As scheduled on Drawings or as required to achieve scheduled performance.
 - 2. Minimum Fin Spacing: 0.083 inch.
 - 3. Tube Diameter: As required to achieve scheduled performance.
 - 4. Number of Rows: As required to achieve scheduled performance, two row minimum.
 - 5. Frames: ASTM A 666, Type 304 stainless steel, minimum 0.0625 inch thick.
 - 6. Mounting: Flanged.
 - 7. Performance: As scheduled on Drawings.

2.03 REFRIGERANT AIR COILS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Aerofin.
 - 2. Carrier Corporation; a unit of United Technologies Corp.
 - 3. Colmac Coil Manufacturing, Inc.
 - 4. Dunham-Bush, Inc.
 - 5. Greenheck Fan Corporation.
 - 6. Heatcraft Worldwide Refrigeration.
 - 7. Trane.
- B. Performance Ratings: Tested and rated according to AHRI 410 and ASHRAE 33.
- C. Minimum Working-Pressure Rating: 300 psig.
- D. Source Quality Control: Factory tested to 450 psig.
- E. Tubes: ASTM B 743 copper, minimum 0.020 inch thick.
- F. Fins: Aluminum, minimum 0.006 inch thick.
- G. Suction and Distributor Piping: ASTM B 88, Type L copper tube with brazed joints.
- H. Capacities and Characteristics:
 - 1. Coil Face Dimensions: As scheduled on Drawings or as required to achieve scheduled performance.
 - 2. Minimum Fin Spacing: 0.083 inch.
 - 3. Tube Diameter: 0.375 inch.
 - 4. Number of Rows: As required to achieve scheduled performance.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine ducts, plenums, and casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before coil installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install coils level and plumb.
- B. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible.
- C. Straighten bent fins on air coils.
- D. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.
- E. Seal joints to eliminate air bypassing coil or leakage from ductwork at coil piping and drain connections.

3.03 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to coils to allow service and maintenance.
- C. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping.

SECTION 23 8219

FAN COIL UNITS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Ducted fan coil units and accessories.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Shop Drawings
 - a. Unit dimensions and weight.
 - b. Required clearances.
 - c. Construction details.
 - d. Field connection details.
 - 2. Cabinet material, metal thickness, finishes, insulation, and accessories.
 - 3. Fans:
 - a. Fan-performance curves with system operating conditions indicated.
 - b. Fan-sound power ratings.
 - c. Fan construction and accessories.
 - 4. Wiring diagrams, motor ratings, electrical characteristics, and motor accessories.
 - 5. Coil-performance ratings with system operating conditions indicated.
 - 6. Dampers, including housings, linkages, and operators.
 - 7. Filters with performance characteristics.

1.03 DESIGN REQUIREMENTS

- A. Unit shall be designed to achieve performance as scheduled on drawings and according to the following requirements:
 - 1. Unit overall unit dimensions shall not exceed the dimensions shown on drawings, unless the specific location for each unit installation is reviewed and adequate space and clearances exist for installation, maintenance, repair and replacement.
 - 2. Unit shall be capable of maintaining external static pressures as scheduled at all operating conditions.
 - 3. Filter Holding Frames:
 - a. Frames shall accommodate commonly available sizes with dimensions in inches. Metric sizes are not acceptable. Standard sizes include: 24-inches, 20-inches, 16-inches, and 12-inches. 24-inch x 24-inch filters are preferred.
 - b. All filters in a holder frame shall be the same size whenever possible.
 - c. Maximum face velocity: 500 fpm.
 - 4. Coil Maximum Face Velocity:
 - a. Heating coils: 700 fpm.
 - b. Cooling coils: 500 fpm.
 - 5. Dampers: 1,200 fpm maximum velocity.
- B. Fan Motor Selection: Fan motor shall be selected based on the following requirements:
 - 1. Motor rated horsepower shall not exceed size scheduled on drawings.
 - 2. Motor horsepower shall be capable of operating unit when filters are loaded to final resistance as specified without exceeding the motor rated amperage.
 - 3. Induction motors shall not operate at frequency greater than 90 hz.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: In addition to items otherwise specified, include the following:
 1. Repair part lists for motors and filters.

1.05 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: Furnish 100% of the total quantity of filters required by all fan coil units provided. Filters shall be clean at date of Substantial Completion. Filters furnished herein shall be in addition to those provided to replace filters used during construction.

1.06 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 "Systems and Equipment" and Section 7 "Construction and Startup."
- C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 "Heating, Ventilating, and Air-Conditioning."

1.07 COORDINATION

A. Coordinate layout and installation of fan coil units and suspension system components with other construction that penetrates or is supported by ceilings, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

PART 2 PRODUCTS

2.01 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. Factory-packaged and -tested units rated according to AHRI 440, ASHRAE 33, and UL 1995.
- C. Surface-Burning Characteristics: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84 by a qualified testing agency.

2.02 DUCTED FAN COIL UNITS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by the following:
 - 1. Engineered Comfort
 - 2. Price Industries
- B. Fan Coil Unit Configurations: Unit shall contain the following components from air inlet to air outlet.
 - 1. Heating Coil: Hydronic.
 - 2. Cooling Coil: Hydronic or direct expansion as scheduled.
 - 3. Supply Fan: Draw through.
- C. Cabinet Construction
 - 1. Frame and Panel Construction: Provide one of the following:
 - a. Casing constructed of 18-ga channel frame. 20-gage steel casing.
 - 1) Single-wall.
 - 2) Insulation: Provide one of the following:
 - a) 1-inch- thick, foil-faced glass fiber complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.
 - 2. Insulated, hinged access panels for supply fan section and filter section.
- D. Direct-Driven Fans: Double width, forward curved, centrifugal; with motor in the fan inlet. Galvanized, aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.
 - 1. Motor: induction motors Comply with requirements in Section 23 05 13 Common Motor Requirements for HVAC Equipment.
 - 2. Vibration isolation: Neoprene mounting.
- E. Belt-Driven Fans: Double width, forward curved, centrifugal; with motor installed on an adjustable fan base in the cabinet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.
 - 1. Motor: Permanently lubricated, fully modulating, variable speed, electrically commentated. Comply with requirements in Section 23 05 13 - Common Motor Requirements for HVAC Equipment.

- 2. Drive Assembly: Comply with requirements in 23 05 00 General HVAC Provisions, Belt Drives for HVAC Equipment.
- 3. Vibration isolation: Neoprene mounting.
- F. Hydronic Coils: Comply with requirements in 23 82 16 Air Coils, except as follows:
 1. Chilled water coils: Coil frame shall be galvanized steel or stainless steel.
- G. Indoor Refrigerant Coils: Comply with requirements in 23 82 16 Air Coils.
- H. Main and Auxiliary Drain Pans: Stainless steel. Fabricate pans and drain connections to comply with ASHRAE 62.1.
- I. Filters and Holding Frames:
 - 1. 2-inch side access holding frame with hinged access door or sliding end plate. Side or bottom opening as required.
 - 2. Filters: Type: F-3. Comply with requirements in 23 41 00 "Particulate Air Filtration"

J. Electrical

- 1. Factory wired motor and controls for single external electrical connection.
- 2. NEMA 250, Type 1 enclosure with hinged door. Internal or exterior mounted.
- 3. Numbered terminal strip.
- 4. Disconnect switch.
- K. Controls
 - 1. 24 VAC transformer
 - 2. BAS Interface: Factory install hardware to enable BAS system to monitor and control unit operation.
 - a. Monitoring:
 - 1) Motor alarm
 - b. Control
 - 1) Motor start-stop command
 - 2) Motor speed, 0-10vdc or 4-20 mA
- L. Capacities and Characteristics: As scheduled on drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas, with Installer present, to receive fan coil units for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before fan coil unit installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install fan coil units level and plumb.
- B. Install fan coil units to comply with NFPA 90A.
- C. Suspend fan coil units from structure. Refer to Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation and seismic support requirements.
- D. Install new filters in each fan coil unit within two weeks after Substantial Completion.
- E. Where secondary condensate drain is required by Code provide one of the following:
 - 1. Install a high-level float switch in drain pan. Interlocked flow switch with motor controller to stop supply fan when high water level occurs. Plug secondary overflow drain connection if provided.
 - 2. Install secondary drain piping.

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

- 1. Install piping adjacent to machine to allow service and maintenance.
- 2. Connect condensate drain to indirect waste.
 - a. Install condensate trap of adequate depth to seal against fan pressure. Install cleanouts in piping at changes of direction.

3.04 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that shipping, blocking, and bracing are removed.
 - 3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete.
 - 4. Verify that overcurrent protection is installed/adjusted in motors, controllers, and switches.
 - 5. Verify free fan wheel rotation and smooth bearing operations.
 - 6. Align belts and install belt guards.
 - 7. Verify that bearings and other moving parts are lubricated.
 - 8. Verify that outdoor- and return-air mixing dampers open and close and that dampers close tightly.
 - 9. Operate electric heating elements through each stage to verify proper operation and electrical connections.
 - 10. Operational Test: After electrical circuitry has been energized start units to confirm proper motor rotation and unit operation.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

SECTION 23 8245

CHILLED BEAMS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes passive and active chilled beams.

1.02 ACTION SUBMITTALS

- A. For each type of product provide product data including:
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for chilled beams.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories for chilled beams.
- B. Shop Drawings: For chilled beams.
 - 1. Include plans, elevations, sections, and mounting and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.03 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Structural members to which chilled beams will be attached.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Location of chilled beams including other building components integrated into chilled-beam configuration including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - 5. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - 6. Perimeter moldings.
 - 7. Chilled-beam frames.
- B. Seismic Qualification Certificates: Submit certification that chilled beams, accessories, and components will withstand seismic forces defined in Section 23 05 48 "Vibration and Seismic Controls for HVAC." 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."
 - 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.

PART 2 PRODUCTS

2.01 ACTIVE CHILLED BEAMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Titus
 - 2. Price Industries
- B. Basis of Design: Price ACBL
- C. Standards:
 - 1. Comply with ASHRAE 55.
- D. Description: Sheet metal with primary air plenum, secondary chilled-water coil and heating-water coil assembly, and mounting-bracket supports suitable for surface mounting.
- E. Components:
 - 1. Panel: Minimum 0.0375-inch- thick, galvanized-steel sheet.
 - 2. Factory Piping: ½-inch outside diameter ASTM B 88, Type L copper tube with ASME B16.22 wrought-copper fittings and brazed joints, and ½-inch NPT male piping connections
 - 3. Hydronic Coils: Copper tube, with mechanically bonded 0.006-inch- thick, aluminum fins spaced no closer than 10 fins per inch, rated for a minimum working pressure of 300 psig and a maximum entering-water temperature of 220°F. Include manual air vent and drain valve.
 - 4. Duct connection: Side-mounted spigot inlet and exhaust connection. Each beam provided with pressure tap on supply inlet for airflow calibration and ½-inch NPT male piping connections.
 - 5. Supply Plenum: Provide 1/8-inch interior Armaflex insulation inside of plenum for condensation control.
 - 6. Primary air slot adjustment: Manually adjustable slot close-off bladed damper.
 - 7. Supply air flow pattern controllers: Manually adjustable air diverter blades to characterized outlet flow distance and throw.
 - 8. Induction grille: Linear bar grille, 50% free area, hinged for coil access, operation without use of tools.
 - 9. Frame:
 - a. T-bar ceilings: compatible with standard 1-inch-wide inverted tee bar ceiling grid system. Provide side and end details for installation in ceiling system.
 - b. Suspended applications: provide factory mounted coanda plates.
- F. Exposed Metal Finish: Sheet metal with baked enamel.
 - 1. Color: Manufacturer's standard paint color as selected by Architect.
 - 2. Surface-Mounted Trim: Sheet metal with baked-enamel finish in manufacturer's standard paint color as selected by Architect.
- G. Capacities and Characteristics: As scheduled on Drawings.

2.02 GENERAL FINISH REQUIREMENTS

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

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas to receive chilled beams for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for hot- and chilled-water piping to verify actual locations of piping connections before installation.

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

3.02 INSTALLATION

- A. Install surface-mounted and lay-in ceiling-mounted chilled-beam units level and plumb.
- B. Coordinate layout and installation of chilled beams and suspension-system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, communications system, security system, and partition assemblies.
- C. Install continuous-thread hanger rods of size required to support chilled-beam weight.

3.03 CONNECTIONS

- A. Where installing piping adjacent to chilled beams, allow space for service and maintenance.
- B. Make piping and ductwork connections to provide best possible service access.

SECTION 23 8339

HYDRONIC UNIT HEATER

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish and install unit heaters as shown with all appropriate accessories.

1.02 ACTION SUBMITTALS

- A. Provide submittals for products listed in the Product Table below in accordance with Section 23 05 00 – General HVAC Provisions. Submittal requirements indicated by column number designation as follows:
 - 1. Materials List
 - 2. Catalog Data
 - 3. Product Data
 - 4. Performance Data
 - 5. Wiring Diagrams
 - 6. Shop Drawings
 - 7. Installation Instructions
 - 8. Special Requirement listed herein.

PRODUCT TABLE	1	2	3	4	5	6	7	8
Hydronic unit heater								

PART 2 PRODUCTS

2.01 HYDRONIC UNIT HEATER

- A. Acceptable Manufacturers: Modine, Trane.
- B. General: Casing, hydronic heating coil, motor, fan assembly, adjustable louver, suspension hanger connection.
- C. Components:
 - 1. Casing: 20-gauge die-formed steel, rigidly constructed, painted with enamel finish.
 - 2. Coils: Aluminum fins mechanically bonded to tubes. Tubes to be seamless copper tubing, pneumatically tested to 300 psig under water. Supply and return connections to be steel.
 - 3. Motor: 115-volt, 60 hertz, single phase, totally enclosed with built-in thermal overloads, shaded pole motors.
 - 4. Fans: Aluminum blades, factory balanced for quiet operation with fan safety guard.
 - 5. Louvers: Adjustable horizontal and vertical blades.
- D. Capacity: As shown on Drawings.

PART 3 EXECUTION

3.01 INSTALLATION

A. Locate where shown on Drawings and install in accordance with manufacturer's installation recommendations and equipment listings.

SECTION 26 0155

ELECTRICAL SYSTEMS FIRESTOPPING

PART 1 GENERAL

1.01 SCOPE

- A. Section includes requirements for through-penetration fire stopping for items including, but not limited to, conduit and cable tray provided under Divisions 26, 27, and 28.
- B. Section also includes requirements for recessing fixtures, cabinets, or devices in fire rated walls, ceilings, and floors.
- C. Products shall be of a single manufacturer for each type of fire stopping required, and where several types are integrated into a single assembly. Provide putty sealants, wraps, boards, and accessories as necessary and required for the work of this project.

1.02 REFERENCES

- A. Underwriters Laboratories:
 - 1. UL Fire Resistance Directory
 - 2. UL Component Listing Test Criteria
 - 3. Warnock Hersey
- B. American Society for Testing and Materials Standards:
 - 1. ASTM E 814 88: Standard Test Method for Fire Tests of Through-Penetration Firestops.
- C. International Building Code, current edition, with Oregon Amendments (Oregon Structural Specialty Code, OSSC, current edition) Chapter 7 Fire Resistance Rated Construction.

1.03 DEFINITIONS

- A. Assembly: Particular arrangement of materials specific to a given type of construction.
- B. Barriers: Time rated fire walls, ceiling/floor assemblies, and structural floors.
- C. Fire Stopping: Assembly of materials applied at penetrations to limit spread of heat, fire, gases, and smoke.
- D. Penetration: Opening through or into a barrier such the full thickness of rated materials is not obtained.
- E. System: Specific products and applications, classified and numbered by Underwriters Laboratories (UL), Inc. to close specific barrier penetrations.
- F. F Rating: Time period that fire stop assembly can withstand fire and hose stream test as determined in UBC Standard 7-5.
- G. T Rating: As required for F Rating and to limit temperature rise above initial temperature to 325 degrees F on protected sides as determined in UBC Standard 7-5.

1.04 SHOP DRAWINGS, PRODUCT DATA, OPERATION MAINTENANCE DATA

- A. Provide manufacturer's installation drawings and instructions for each proposed assembly. Identify intended product and applicable UL System number or UL classified devices.
- B. Provide manufacturer recommendations and drawings relating to non-standard applications where necessary.

1.05 QUALITY ASSURANCE

A. Installer Qualification: Acceptable to, or certified by, Fire Stopping system manufacturer.

- B. Regulatory Requirement: Contractor shall verify acceptance from Authority Having Jurisdiction for proposed assemblies conforming to, or not conforming to, specific UL Fire Stop System Numbers, or UL classified devices.
- C. Products shall comply with the requirements of Oregon Revised Statute (ORS) 453.005 (7) (e), effective January 1, 2011. The referenced statute limits the use of three types of brominated fire-retardant chemicals, which are defined as hazardous substances.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in original, unopened packaging with legible manufacturer's identification. Store materials in accordance with manufacturer's instructions. Store in clean, dry, ventilated location, protected from freezing.

1.07 WARRANTY

A. Submit copies of written warranty for Fire Stopping assemblies. Warranty period shall be one year minimum.

PART 2 PRODUCTS

2.01 GENERAL

- A. Fire Stop products and accessories shall be asbestos-free, intumesce when exposed to temperatures of 250 degrees F, and maintain an effective barrier against flame, smoke and gases. Mortar systems must be Warnock Hersey approved.
- B. Fire Stop Fire Rating: Not less than the rating of barrier penetrated in which fire stopping will be installed.

2.02 FIRE STOPPING ASSEMBLIES

- A. Assemblies of materials used to seal spaces around penetrations shall have a UL Fire Stop System Number appropriate for the construction type, penetration type, annular space requirements, and fire rating at each penetration.
- B. Systems and devices must withstand the passage of cold smoke either as an inherent property of the system or by the use of a separate product included as part of the UL system or devices and designed to perform this function. Systems complying with the requirements for throughpenetration firestopping in fire-rated construction are acceptable provided the system will provide a smoke seal.
- C. Performance Requirements: Fire Stop assembly shall be able to withstand standard fire and hose stream test (F Rating) and limit temperature rise (T Rating) of penetrations on protected side as required by Authorities Having Jurisdiction. Conform to UBC Standard 7-5.
- D. Manufacturers: 3M, Dow, Chase Technology Corp., Bio Fireshield Inc., Johns Manville, Specified Technologies Inc., Metacaulk, GS Hevi-Duti/Nelson, or approved.

2.03 ACCESSORIES

- A. Fill, void, or cavity materials: As classified under category HHW in the UL Fire Resistance Directory.
- B. Forming materials: As classified under category HKU in the UL Fire Resistance Directory.

PART 3 EXECUTION

3.01 GENERAL

A. Provide Fire Stopping seal at cable tray, wiring, or conduit penetration, installed under Divisions 26, 27 and 28, through fire rated construction.

- B. Provide fire rated assembly around electrical devices, panelboards, outlet boxes, back boxes, cabinets, and luminaires recessed in fire rated walls and ceilings. See Architectural drawings for locations of fire rated walls and ceilings.
- C. Verify barrier penetrations are properly sized and in suitable condition for application of materials.
- D. Provide masking and drop cloths to prevent contamination of adjacent surfaces by Fire Stopping materials. Clean spills of liquid components. Remove equipment, materials and debris, leaving area in undamaged, clean condition.
- E. Clean surfaces to be in contact with penetration seal materials of dirt, grease, oil, loose materials, rust, or other substances that may affect proper fitting, adhesion, or the required fire resistance. Cut and trim materials as required to neatly match edges of penetration.
- F. Comply with manufacturer's recommendations for temperature and humidity conditions before, during, and after installation of Fire Stopping.

SECTION 26 0500

GENERAL ELECTRICAL PROVISIONS

PART 1 GENERAL

1.01 CONTRACT DOCUMENTS

- A. General electrical provisions apply to all work performed in Division 26, 27 & 28.
- B. The Contract Documents are complementary. What is required by any one, as affects this Division, shall be as binding as if repeated herein.
- C. Separation of this Division from other Contract Documents shall not be construed as segregation of the Work.
- D. Location of equipment on Drawings is approximate. Plan exact location with respect to site measurements and work of other trades prior to starting work. If measurements differ slightly, modify work. If measurements differ substantially, notify Architect and Owner's Authorized Representative prior to fabrication.
- E. Make minor changes in equipment connections and equipment locations as directed or required before rough-in without extra cost.
- F. Use of the word "Provide" shall be equivalent to "Furnish and Install."
- G. For products specified by listing one or more manufacturers, followed by "Similar to" and one manufacture's model number, the following requirements apply:
 - 1. Approval of each listed manufacturer is contingent upon that manufacturer having a product which meets the specification, fits in the available space, and is comparable to the listed model.
 - 2. Electrical and space requirements indicated on drawings are based on the listed model and may not be suitable for all manufacturers listed. Provide revisions required to accommodate the model actually furnished.
- H. For products specified by listing one or more manufacturers, followed by a model number for each manufacturer, the following requirements apply:
- I. Provide one of the listed model numbers or an approved substitution.
- J. Electrical and space requirements indicated on the Drawings are based on one of the listed models, and may not be suitable for all models listed. Provide revisions required to accommodate the model actually furnished.

1.02 DEFINITIONS

- A. Authority Having Jurisdiction (AHJ): The governmental agency or sub-agency which regulates the construction process.
- B. Owner's Authorized Representative (OAR): Owner's representative with authority to act on Owner's behalf.
- C. Provide: Equivalent to "Furnish and Install."

1.03 COORDINATION

- A. Reference drawings of other trades to avert possible installation conflicts. Should major changes from original drawings be necessary to resolve such conflicts, notify Architect and secure written approval and agreement on necessary adjustments before commencing work.
- B. Architectural drawings govern all other drawings. Reference Architectural drawings for door swings, counter heights and similar items affecting work before rough-in.
- C. Coordinate identification systems with other trades. All electrical systems shall use identical wiring, conduit, and equipment identification and regulatory signage.

1.04 SUBMITTALS AND SHOP DRAWINGS

- A. See Division 01
- B. Action Submittal Content

- 1. Action submittal information not expressly required by the specifications will not be reviewed.
- 2. Action submittal information shall be provided in sufficient detail to establish conformance with specified requirements. Where submitted literature includes multiple models, features, or options, the specific models, features, or options proposed shall be clearly indicated. Where a brief inspection shows that product data is not complete, the submittal will be rejected without review.
- 3. Action submittal data shall be clear, concise, legible, and relevant. Where data is not properly organized and contains significant information that is not relevant, the submittal will be rejected without review.
- 4. Action submittal requirements are listed in individual specification sections. The following definitions apply.
 - a. Materials List: Provide tabular list of materials including specification reference, specification product name, manufacturer, model/part number, and size and/or quantity where appropriate. Do not include supplemental data, except where specifically requested.
 - b. Catalog data: Manufacturer's standard product cut sheet.
 - c. Product Data: Detailed data including dimensions, weight, materials of construction, connections, and all other information needed to confirm that the product conforms to all requirements listed in the individual specification section.
 - d. Performance Data: Capacity, input, output, flow, etc. as required to confirm that the product meets the performance requirements scheduled in the Specifications or on the Drawings.
 - e. Wiring Diagrams: Power and control wiring diagrams.
 - f. Shop Drawings: Construction drawings of items manufactured specifically for this project including dimensions, construction details, weights, and additional information to identify the physical features of the system or piece of equipment.
 - g. Installation Instructions
 - h. Special Requirements Listed: Additional requirements indicated in individual specification sections.
- C. Delegated Design
 - Delegated work will include but is not limited to the following:
 - a. Section 26 0548 Seismic Control for Electrical Systems.
 - b. Section 26 3100 Photovoltaic Systems
 - c. Section 28 1300 Access Control System.
 - d. Section 28 2300 Video Surveillance System.
 - e. Section 28 3100 Fire Alarm.
 - 2. 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.
 - a. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.
 - 3. Delete requirement if not applicable
 - 4. Delegated-Design Services Certification: In addition to shop drawings, product data, and other required submittals, submit digitally signed PDF electronic file, 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.
 - a. 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.
- D. Sustainable Design Requirements
 - 1. See Division 01 for procedures used to establish compliance with the US Green Building Council LEED prerequisites and credits established for the project.

1.05 Coordination Drawings

- A. Coordination Drawings, General:
 - 1. See Division 01 for Coordination Drawing content and format.
 - 2. Notify Architect of Construction Document discrepancies and conflicts where installation requirements require greater space than is available and cannot be resolved through trade coordination efforts alone.
 - 3. Model to cover entirety of building, including foundation, roof and site, as required to convey full scope of work.
 - 4. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts.
 - 5. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - a. Coordinate the addition of trade-specific information to coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - b. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - c. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - d. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - e. Indicate required installation sequences.
 - f. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
 - 1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 - 2. Elevator Machine Rooms: Provide coordination drawings for elevator machine rooms showing plans and elevations of elevator machinery, mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 - 3. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/2 inches in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panelboard, switchboard, switchgear, transformer, busway, generator, and motor-control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
 - 4. Review: Architect will review coordination drawings to confirm that in general the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.

1.06 QUALITY ASSURANCE

- A. All materials and equipment provided hereunder shall be installed and started in complete conformance with the manufacturer's recommendations.
- B. Asbestos products or equipment or materials containing asbestos shall not be used.

C. Certify that each welder has passed the American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.

1.07 DESIGN REQUIREMENTS

- A. Equipment and systems provided hereunder shall be rated to provide performance specified and scheduled on Drawings at the elevation of the project site.
- B. Materials and equipment provided hereunder shall be rated for the service conditions of the system to which they are connected including but not limited to temperature, pressure, and humidity.

1.08 CODES AND STANDARDS

- A. Applicable codes and standards shall determine minimum requirements for materials, methods, and labor practices not otherwise stated herein.
- B. Work shall comply with the Americans with Disabilities Act (ADA).

1.09 TEMPORARY SERVICES

- A. Provide in accordance with Division 01 as required for completion of work. Provide additional filters as required to keep areas clean during construction.
- B. Maintain existing systems operational. Owner will be responsible to operate and maintain existing equipment during the course of the project. However, any damage to existing equipment resulting directly from work under this Contract shall be repaired by the Contractor at no expense to Owner.

1.10 OPERATIONS AND MAINTENANCE MANUALS

- A. Prepare a digital file in Portable Document Format (PDF), clearly indexed with bookmarks for each item or product. Include a directory of all subcontractors and maintenance contractors with names, addresses, and telephone numbers, indicating the area of responsibility for each. Index bookmarks shall match submittal schedule and include any additional information required for operations and maintenance, whether in submitted schedule or not.
- B. Maintenance instructions shall indicate routine-type work with step-by-step instructions that should be performed to ensure long life and proper operations. Recommended frequency of performance shall also be included.
- C. Provide copy of approved submittal for each product included in manual
- D. Provide printed copy and electronic configuration files for all packaged equipment control systems furnished with equipment.
- E. Mark the model actually provided where the literature covers more than one model. Include four copies of all submittal data corrected to "as-built" conditions within the manual.
- F. Provide a composite summary table indicating each item of equipment listed in the operations and maintenance manual and its required maintenance and time period. This summary table shall be the first section in the O&M manual.
- G. Manual Content: Manuals shall contain complete information for each item of mechanical electrical or other operating equipment. Include as applicable:
 - 1. Manufacturer's instructions for installation, startup, operation, inspection, and maintenance
 - 2. Performance capacity
 - 3. Catalog data sheets
 - 4. Parts list
 - 5. Maintenance schedules

1.11 RECORD DRAWINGS

A. Provide record "as-built" drawings in accordance with Division 1 requirements. Show all deviations from contract drawings and location of underground lines by accurate dimensions from building lines. Show depth of stub outs and underground lines. Dimension all concealed piping from column grids or building lines. Concealed raceways, that contain feeder cables,

communication conduits that are 1.5-inch diameter or greater shall be dimensioned from column grids or building lines. Alternately, provide electronically using PDF markup of contract drawings.

1.12 DEMONSTRATION

- A. General: After installation is complete, demonstrate to Engineer and Owner's Authorized Representative satisfaction as being complete and operational and entirely in conformance with Contract Documents.
- B. Preparation: Prior to demonstration, submit check-off list indicating completeness of submittals and certificates of compliance for review to Owner's Authorized Representative. Operate completed system for one week. Verify that control verification is complete and verification report has been approved by Architect.
- C. Arrange for demonstration with Owner, Engineer, required factory technicians, and installer at least one week in advance of demonstration.

1.13 TRAINING

- A. Instruct Owner in proper operation and maintenance of equipment and systems. Instruction shall generally include topics listed in manufacturer's operations and maintenance manual. Operator instructions shall cover all aspects of manual, automatic, and safety controls. Contractor shall also instruct the Owner in the general configuration of systems and location of equipment and components.
- B. Furnish competent qualified technicians knowledgeable in the building electrical and lighting systems and equipment provided for this project for a minimum of 8 hours on-site to instruct Owner in operation and maintenance of systems and equipment. This figure does not include additional training noted under individual specification sections. Contractor shall keep a log of this instruction including date, times, subjects, and those present and shall present such log when requested by Engineer. Contractor shall coordinate training with Owner's Project Manager and provide a schedule for training minimum two-weeks prior to Substantial Completion. All training shall be complete 30-days after Substantial Completion.
- C. Contractor shall furnish training by equipment manufacturers in addition to training described in this section where specifically listed in other sections. Contractor shall schedule training with Owner's Project Manager minimum 48-hours prior to training session. Equipment shall be fully operational prior to scheduling training session. Manufacturer's field start-up, adjustment, and service will not fulfill manufacturer's training requirement.

1.14 WARRANTY

- A. Warrant all Work included in the Specification for a period of one year from the date of substantial completion, under provisions of Division 1.
- B. During warranty period, remedy without delay or expense to Owner any defects providing, in judgement of Engineer, that such defects are not a result of misuse or abuse on part of Owner.
- C. Warrant that all equipment and installations are in compliance with OSHA regulations.

PART 2 PRODUCTS

2.01 PRODUCTS AND MATERIALS

- A. All materials employed in permanent construction shall be new, full weight, in first class condition, and suitable for space provided. All similar equipment and materials shall be of one manufacturer.
- B. Equipment used as the basis of design is scheduled on Drawings or designated in product specifications. If Contractor chooses to use equipment that is not the basis of design, Contractor is responsible for all re-design and construction costs associated with variations in arrangement, dimension, or capacity. Such work may include, but is not limited to, changes to facility structure or dimensions and revisions to associated mechanical and electrical systems needed to provide equal system performance and maintainability.

2.02 ELECTRICAL EQUIPMENT

- A. Electrical Disconnect Switch: Electrical disconnect switches specified for mechanical equipment shall conform to OSHA Lock-out/Tag-out requirements.
- B. All electrical equipment shall be listed as approved for its application by the Underwriters Laboratory or other testing agency approved by the State of Oregon Electrical and Elevator Board. Approval indicates agency meets testing standard requirements for electrical safety required by Oregon Revised Statutes 479.510 through 479.855 and Oregon Administrative Rules.
- C. Enclosure: Provide the following electrical equipment enclosure types.
 - 1. NEMA 1: Dry, enclosed locations where the ambient temperature will not be outside of the equipment temperature ratings.
 - 2. NEMA 12: Enclosed mechanical spaces equipped with floor drains where dripping or splashing may occur and where the ambient temperature will not be outside of the equipment temperature ratings.
 - 3. NEMA 3R: Outdoors or in spaces where sustained water spray is possible.
 - 4. NEMA 3R: with Temperature Control: Outdoors or in unconditioned spaces where ambient temperatures will be outside of the equipment temperature ratings.
 - 5. NEMA 4 : Outdoors or in spaces that are corrosive environments.

2.03 EQUIPMENT CONNECTIONS

- A. Provide a complete electrical connection for all items of equipment including incidental wiring, materials, devices and labor necessary for a complete operating system. The location and method for connection to each item of equipment shall be verified prior to rough-in. The voltage and phase of each item of equipment shall be checked prior to connecting. Motor rotations shall be made in the proper direction. Pump motors are not to be test run until liquid is in the system and proper lubrication to all bearings in unit is checked.
- B. Conduit, wire and circuit breaker sizes for mechanical and similar equipment are based on the equipment ratings of one manufacturer. The equipment actually furnished may have different electrical characteristics. Conduit, wire, and circuit breakers shall not be ordered or installed until exact electrical requirements are obtained. The Contractor is responsible for this coordination.

2.04 FIRESTOPPING

- A. See Division 07
- B. Acceptable Manufacturers: 3M, Hilti, Tremco, Nelson Firestop Products.
- C. Provide firestopping for the following:
 - 1. All penetrations through fire resistance rated floors, walls and partitions including openings containing pipes, ducts and other penetrating items.
 - 2. All penetrations through non-fire resistance rated floors where the vertical service riser penetrates three or more floors.
- D. Firestop system shall be UL Classified for the application and correspond to those indicated by reference to designation listed by UL Fire Resistance Directory.
- E. Material shall be tested in accordance to UL-1479, ASTM E-814 for the specific fire-rated construction conditions confirming to construction assembly type, penetration item type, annular space requirements, and fire-rating involved.

PART 3 EXECUTION

3.01 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31.
- B. Excavation
 - 1. Contact utilities before starting any excavation to locate underground services on site or in adjacent streets.
 - 2. Locate and protect any existing underground services.
 - 3. Repair any services damaged.

- C. Trenching and Backfilling
 - 1. Provide trenching and backfilling to depth required for underground conduit, per NEC and/or Utility requirements, 36 inches minimum.
 - 2. Backfilling prior to inspection of installation by Owner's Authorized Representative and serving Utility not permitted.
 - 3. Minimum backfill requirements:
 - a. Raceways run beneath building slabs, beneath areas to be paved and beneath streets and sidewalks.
 - 1) Use ¼ inch to 1-inch diameter, crushed or clean round river rock.
 - b. Underground raceway runs at all other locations.
 - 1) Backfill in compacted layers not exceeding 6 inches in depth.
 - 2) Use sand or "clean" earth free form rock larger than 1 inch in diameter and debris.
 - c. Provide one continuous #14 copper conductor as a tracing conductor for locating the conduits in the future. Install the tracing conductor at the center line of the upper-most conduit in the trench. Install one tracing conductor in each conduit trench for each 4-foot trench and one for each additional trench width of less than 4 feet wide. (i.e., provide one for a trench up to 4-feet wide, two for 5-8 feet wide, three for 9-12 feet wide, etc.). Provide a 6-foot coil of tracing wire at each end of the trench clearly marked on an identification tag: "TRENCH TRACING CONDUCTOR". Also include the tracing conductor designation and description of the conduits/conductors in the trench. The identification tag shall be machine generated text, enclosed in a waterproof clear plastic seal, and attached to the coil by means of a tie wrap.
- D. Trenching and Backfilling for Services:
 - 1. Coordinate with all utilities for joint trench service Work.
 - 2. Uncover existing utilities by hand digging only.
 - 3. Size to accommodate all utility service conduits and accessories.
- E. Power digging only in direction away from existing facilities.
- F. Route trenching in manner to avoid weakening footings.
- G. Restore, to Owner's Authorized Representative's satisfaction at no additional expense, any sidewalks, landscaping, or other existing structure damaged due to excavation.

3.02 ACCESS TO EQUIPMENT AND ACCESSORIES

- A. Install equipment with sufficient access for service. Where not conveniently accessible by other means, provide adequately sized access doors for junction & pull boxes, relays & power packs, and all other electrical equipment requiring access for removal or maintenance. Type, size and exact location of access doors shall be coordinated with Architect prior to work.
- B. Provide clearances for maintenance access as indicated on Drawings or as recommended by manufacturer. If access requirements shown on Drawings conflict with manufacturer's recommendations, provide larger clearance of the two.
- C. If equipment location shown on Drawings does not allow required access, notify Architect prior to start of work.
- D. Apply and install all items in accordance with manufacturer's written instructions. Refer conflicts between the manufacturer's instructions and the contract drawings and specifications to Architect for resolution prior to starting work.
- E. Provide access doors as required for access to electrical equipment. Doors required for access are not necessarily shown on Drawings. Consult with Architect for direction on placement of required doors not shown on Drawings.
 - 1. Comply with manufacturer's instructions for installation of access doors. Provide all necessary support and supplemental framing for assembly where the access doors are required. Set accurately in position, plumb, level, and flush to adjacent finish surfaces; and secure to support.

3.03 ARRANGEMENT AND INSTALLATION OF ELECTRICAL EQUIPMENT AND CONDUIT

- A. Coordinate location of conduit, sleeves, inserts, hangers, cable trays and equipment. Locate conduit, sleeves, inserts, hangers, cable tray and equipment clear of windows, doors, openings, lights, ducts, piping, and other services and utilities. Follow manufacturer's published recommendations for installation methods not otherwise specified.
- B. Equipment and Conduit Support: Coordinate structural systems necessary for conduit and equipment support with pipe and equipment locations to permit proper installation.
- C. Location of conduit sleeves, trenches and chases shall be accurately coordinated with equipment and conduit locations.
- D. Minor Conduit: Small diameter conduit runs from receptacles, lighting, equipment, and similar minor services are generally not shown but must be provided. Contractor is responsible to provide all such minor conduit where needed to maintain electrical spaces clean and neat and to allow full equipment function and maintenance.
- E. Inaccessible Equipment
 - 1. Where the Owner's Authorized Representative determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost to the Owner.
 - 2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

3.04 RIGGING

- A. Design is based on use of available structure without modification except as specifically shown. Existing openings in building structures are planned to accommodate design scheme.
- B. Alternative methods of equipment delivery may be offered by Contractor and will be considered by Architect under specified restrictions of phasing and maintenance of service as well as structural integrity of the building.
- C. Close all openings in the building when not required for rigging operations to maintain proper environment in the facility for Owner's operation and maintenance.
- D. Contractor shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility. Where it is not clear that the building structure has adequate capacity to support rigging, Contractor shall check all clearances, weight limitations and shall offer a rigging plan designed by a Registered Professional Engineer. All modifications to existing building structure, including reinforcement thereof, shall be at Contractor's cost, time and responsibility.
- E. Restore building to original condition upon completion of rigging work.

3.05 ELECTRICAL SYSTEMS FIRESTOPPING

- A. Do not cover firestop installations until they are examined by the Authority Having Jurisdiction, if required.
- B. Install firestopping in accordance with manufacturer's recommendations and conditions of product UL listing.

3.06 CLEANING SYSTEMS

- A. General: After all equipment, conduits and cable tray are installed, system shall be thoroughly cleaned. Remove all nonessential stickers and labels from equipment or fixtures. Clean all light fixture lenses. Clean interior of conduit systems prior to installation of wiring.
- B. Repair or replace any discolorations or damage to systems, building finish, or furnishings resulting from Contractor's failure to properly clean system.

3.07 START UP

- A. The Electrical Contractor shall be responsible for proper operation of all systems and shall coordinate startup procedures, calibration and system checkout. System operational problems shall be diagnosed and corrected as required for system operation prior to Substantial Completion inspection.
- B. Start equipment in accordance with manufacturer's recommendations and under manufacturer's supervision where required. Ensure that associated breakers, relays, , electrical overloads, and other devices intended to protect the equipment are installed and functional prior to startup.

3.08 EXTRA STOCK

A. Provide extra stock, as described in individual sections, to Owner in accordance with Division 1.

SECTION 26 0519

LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - Copper building wire rated 600 V or less. 1.
 - Photovoltaic cable, Type PV, rated 1000 V or less. 2.
 - 3. Connectors, splices, and terminations rated 600 V and less.

1.03 DEFINITIONS

- A. PV: Photovoltaic.
- B. RoHS: Restriction of Hazardous Substances.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.

1.05 INFORMATIONAL SUBMITTALS

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

1.06 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing. 1.

PART 2 PRODUCTS

2.01 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.
- Manufacturers: Subject to compliance with requirements, available manufacturers offering Β. products that may be incorporated into the Work include, but are not limited to the following:
 - 1. American Bare Conductor.
 - 2. Cerro Wire LLC.
 - General Cable Technologies Corporation. 3.
 - Okonite Company (The). 4.
 - 5. Southwire Company.
- Standards: C.
 - Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for 1 intended location and use.
 - 2. RoHS compliant.
 - Conductor and Cable Marking: Comply with wire and cable marking according to UL's 3. "Wire and Cable Marking and Application Guide."
- D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- E. Conductor Insulation:
 - Type THHN and Type THWN-2: Comply with UL 83. 1.
 - Type HHW-2: Comply with UL 44. 2.
- F. Ninety-eight percent conductivity, minimum.
- G. Branch Circuit Wiring: Conductors smaller than No. 12 AWG for power system branch circuits not permitted.
- H. Motor control wires shall be No. 14 minimum.

2.02 PHOTOVOLTAIC CABLE, TYPE PV

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 2000 V.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Encore Wire Corporation.
 - 2. General Cable; General Cable Corporation.
 - 3. Southwire Company.
- C. 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."
- D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- E. Conductor Insulation: Comply with UL 44 and UL 4703.

2.03 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. 3M Electrical Products.
 - 2. AFC Cable Systems.
 - 3. Gardner Bender.
 - 4. Ideal Industries, Inc.
 - 5. Burndy
 - 6. Thomas & Betts Corporation.
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
 - 1. Material: Copper.
 - 2. Type: Two hole with standard barrels.
 - 3. Termination: Compression.

PART 3 EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Stranded conductors only.
- B. Branch Circuits: Copper. Stranded conductors only.
- C. Branch Circuits: Copper. Solid or stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- D. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.
- E. VFD Output Circuits Cable: Shall utilize stranded, type HHW-2 conductors.
- F. Power-Limited Fire Alarm and Control: Solid for No. 14 AWG and smaller.
- G. PV Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

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3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.
- B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- E. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- F. VFD Output Circuits: Type HHW-2 in metal conduit.
- G. PV Circuits: Type PV for PV source circuits rated at 600 V.
- H. MC cable not allowed.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Use no wire smaller than No. 12 AWG for power and lighting circuits and no smaller than No. 16 AWG for control wiring.
- C. Use No 10 AWG conductors for 20 amperes, 120-volt branch circuit home runs longer than 100 feet, and for 20 ampere, 277-volt branch circuit home runs longer than 200 feet. Neutral conductor shall be sized the same as corresponding phase conductors.
- D. Metal-clad (MC) cable permitted for final connection to one light fixture from a single junction box. Daisy chaining fixtures or junction boxes with MC cable is not permitted.
- E. Provide dedicated neutral conductor with each branch circuit, do not use a shared neutral conductor between phases unless specifically requested or directed.
- F. For remodel work or where shared neutrals are used by equipment such as system furniture, provide a breaker handle tie as required for the phases sharing the neutral conductor.
- G. Conductor length for parallel feeders shall be identical.
- H. Complete raceway installation between conductor and cable termination points according to Section 26 0533 – Raceways and Boxes for Electrical Systems prior to pulling conductors and cables.
- I. 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.
- J. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- K. Couplings and conduit connectors shall have pre-insulated bushings in place prior to pulling wires.
- L. Splice only in accessible junction or outlet boxes. Splice in feeders and services are not permitted. Splice or taps in branch circuits permitted only in junction boxes where circuits divide.
- M. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
- N. Support cables according to Section 26 0529 Hangers and Supports for Electrical Systems.
- O. Lace or clip groups of feeder conductors at distribution centers, pullboxes, and wireways.
- P. Provide copper grounding conductors and straps. A ground wire shall be pulled through conduits and used as the equipment grounding conductor.

- Q. Wire and cable shall be brought to the job site in the original containers bearing the U.L. label.
- R. Installing wires of different voltage systems in the same raceway, box, gutter or other enclosure is prohibited.
- S. Radius of cable bends shall not be less than ten times the outer diameter of the cable.

3.04 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torquetightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Follow manufacturer's instructions using manufacturer's recommended tools.
- D. Stripping Insulation: Carefully strip, avoid nicking conductor. No "ringing".
- E. Design: Connectors shall be designed and approved for the purpose used. Connectors between aluminum and copper shall be listed "AL/CU" for the purpose of preventing electrolytic action.
- F. Bare Connectors and Conductor Free Ends: Wrap with insulating rubber or friction tape to equivalent insulation of wire.
- G. Ground Continuity to Metallic Surfaces: Remove any paint coating and polish surface beneath connection.
- H. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.
- I. No splices or taps permitted in feeder branch circuiting terminating at a single outlet.
- J. Conductor and cable copper shall not be reduced at the terminal for making connections.

3.05 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 26 0553 Identification for Electrical Systems.
- B. Color-coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - 1. Color shall be factory applied integral pigmentation or field applied for sizes larger than No. 6 AWG if authorities having jurisdiction permit. Where field applied, apply colored plastic tape in spiral half-lap over exposed conductor portions in manholes, boxes, panels, switchboards, and other enclosures.
 - 2. Colors for 208/120-V circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - d. Neutral: White with corresponding phase color stripe.
 - 3. Color for Equipment Grounds: Green
 - 4. Color for Isolated Grounds: Green with yellow stripe.
- C. Identify each spare conductor at each end with identity number and location of other end of conductor and identify as spare conductor.

3.06 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07.

3.07 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.

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- 2. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Continuity test on each conductor and cable.
 - g. Uniform resistance of parallel conductors.
 - h. Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts dc for 300-volt rated cable and 1000 volts dc for 600-volt rated cable. Test duration shall be one minute.
- B. Cables will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION

SECTION 26 0526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
- B. Related Requirements:
 - 1. Section 26 0500 "General Electrical Provisions" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 26 0548 "Seismic Controls for Electrical Systems" for seismic-load, wind-load, and other field conditions applicable to Work specified in this Section.

1.02 ACTION SUBMITTALS

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

1.03 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Ground rods.
 - 3. Ground rings.
 - 4. Grounding arrangements and connections for separately derived systems.
- B. Field quality-control reports.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

PART 2 PRODUCTS

2.01 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.

2.02 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B3.
 - 2. Stranded Conductors: ASTM B8.
 - 3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inch in cross section, with 9/32 inch holes spaced 1-1/8 inch apart. Stand-off insulators for mounting must comply with UL 891 for use in switchboards, 600 V and must be Lexan or PVC, impulse tested at 5000 V.

2.03 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.
- C. Mechanical-Type Bus-Bar Connectors: Cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- D. Compression-Type Bus-Bar Connectors: Copper or copper alloy, with two wire terminals.
- E. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- F. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- G. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- H. Conduit Hubs: Mechanical type, terminal with threaded hub.
- I. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex-head bolt.
- J. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex-head bolt.
- K. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- L. Water Pipe Clamps:
 - 1. Mechanical type, two pieces with zinc-plated bolts.
 - a. Material: Tin-plated aluminum.
 - b. Listed for direct burial.
 - 2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

2.04 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad Zinc-coated Stainless steel, sectional type; 5/8 by 96 inch.
- B. Ground Plates: 1/4 inch thick, hot-dip galvanized.

PART 3 EXECUTION

3.01 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Grounding Conductors: Green-colored insulation with continuous yellow stripe.
- C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers 2 inch minimum from wall, 6 inch 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.
- D. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 3. Connections to Structural Steel: Welded connectors.

3.02 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors must be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.03 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode must be connected to the equipment grounding conductor and to the frame of the generator.

3.04 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.05 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. Use exothermic welds for all below-grade connections.
 - 3. For grounding electrode system, install at least two rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 26 0543 "Underground Ducts and Raceways for Electrical Systems," and must be at least 12 inch deep, with cover.
 - 1. Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install 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.
- E. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
- G. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 ft. apart.
- H. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.
 - 1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
 - 2. Bury ground ring not less than 24 inch from building's foundation.
- I. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 ft. of bare copper conductor not smaller than No. 4 AWG.
 - 1. If concrete foundation is less than 20 ft. long, coil excess conductor within base of foundation.

- 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.
- J. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
 - 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.06 FIELD QUALITY CONTROL

- A. 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, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 - 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- B. Grounding system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.
- D. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 26 0529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Steel slotted support systems.
 - 2. Aluminum slotted support systems.
 - 3. Nonmetallic slotted support systems.
 - 4. Conduit and cable support devices.
 - 5. Support for conductors in vertical conduit.
 - 6. Structural steel for fabricated supports and restraints.
 - 7. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
 - 8. Fabricated metal equipment support assemblies.
- B. Related Requirements:
 - 1. Section 26 0548 Seismic Controls for Electrical Systems for products and installation requirements necessary for compliance with seismic criteria.

1.03 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 the following:
 - a. Slotted support systems, hardware, and accessories.
 - b. Clamps.
 - c. Hangers.
 - d. Sockets.
 - e. Eye nuts.
 - f. Fasteners.
 - g. Anchors.
 - h. Saddles.
 - i. Brackets.
 - j. Insert product type.
 - 2. Include rated capacities and furnished specialties and accessories.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. For fabrication and installation details for electrical hangers and support systems.
 - 1. Hangers. Include product data for components.
 - 2. Slotted support systems.
 - 3. Equipment supports.
 - 4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated-Design Submittal: For hangers and supports for electrical systems.
 - 1. Include design calculations and details of hangers.
 - 2. Include design calculations for seismic restraints.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

- 1. Suspended ceiling components.
- 2. Ductwork, piping, fittings, and supports.
- 3. Structural members to which hangers and supports will be attached.
- 4. Size and location of initial access modules for acoustical tile.
- 5. Items penetrating finished ceiling, including the following:
 - a. Luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Projectors.
- B. Seismic Qualification Data: Certificates, for hangers and supports for electrical equipment and systems, 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. 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.
- C. Welding certificates.

1.05 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M.
 - 2. AWS D1.2/D1.2M.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 to design hanger and support system.
- B. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified."
 - 2. Component Importance Factor: 1.5.
- C. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame Rating: Class 1.
 - 2. Self-extinguishing according to ASTM D 635.

2.02 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inchdiameter holes at a maximum of 8 inches o.c. in at least one surface.
 - 1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 2. Material for Channel, Fittings, and Accessories: Galvanized steel.
 - 3. Channel Width: Selected for applicable load criteria.
 - 4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 5. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 7. Retain subparagraph below if retaining "Nonmetallic Coatings" or "Painted Coatings" Subparagraph above.
 - 8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- B. Aluminum Slotted Support Systems: Extruded-aluminum 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Eaton.
 - b. Flex-Strut Inc.
 - c. Unistrut; Atkore International.
 - 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 3. Channel Material: 6063-T5 aluminum alloy.
 - 4. Fittings and Accessories Material: 5052-H32 aluminum alloy.
 - 5. Retain first option in "Channel Width" Subparagraph below to allow Contractor to select size of slotted support system.
 - 6. Channel Width: Selected for applicable load criteria.
 - 7. Retain "Nonmetallic Coatings" or "Painted Coatings" Subparagraph below, or both. Coordinate with appropriate coating or painting Section.
 - 8. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 9. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 10. Retain subparagraph below if retaining "Nonmetallic Coatings" or "Painted Coatings" Subparagraph above.
 - 11. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin 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; Atkore International.
 - b. Cooper B-line; brand of Eaton, Electrical Sector.
 - c. G-Strut.
 - 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 3. Retain first option in "Channel Width" Subparagraph below to allow Contractor to select size of slotted support system.
 - 4. Channel Width: Selected for applicable load criteria.
 - 5. Fittings and Accessories: Products provided by channel and angle manufacturer and designed for use with those items.
 - 6. Fitting and Accessory Materials: Same as those for channels and angles.
 - 7. Rated Strength: Selected to suit applicable load criteria.
 - 8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for 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.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

- 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Hilti, Inc.
 - 2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
- 2. Mechanical-Expansion Anchors: Insert-wedge-type, steel, for use in hardened Portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Cooper B-line; brand of Eaton, Electrical Sector.
 - 2) Hilti, Inc.
 - 3) MKT Fastening, LLC.
- 3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
- 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
- 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
- 6. Toggle Bolts: All-steel springhead type.
- 7. Hanger Rods: Threaded steel.

2.03 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 for steel shapes and plates.

PART 3 EXECUTION

3.01 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 102.
 - 4. NECA 105.
 - 5. NECA 111.
- B. Comply with requirements in Division 07 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 26 0533 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 two-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.

3.02 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT IMC and RMC may be supported by openings through structure members, according to NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Retain first subparagraph below if powder-actuated devices are allowed. Consider deleting if Project contains both lightweight and standard-weight concrete or more than one thickness of concrete slab.
 - 6. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 - 7. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
 - 8. To Light Steel: Sheet metal screws.
 - 9. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Metal Fabrications for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use **3000** psi Insert value , 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03.
- C. Anchor equipment to concrete base as follows:
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.05 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Division 09 for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 26 0533

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings.
 - 2. Nonmetallic conduits and fittings.
 - 3. Metal wireways and auxiliary gutters.
 - 4. Nonmetal wireways and auxiliary gutters.
 - 5. Surface raceways.
 - 6. Boxes, enclosures, and cabinets.
 - 7. Handholes and boxes for exterior underground cabling.

1.03 DEFINITIONS

- A. GRC: Galvanized rigid steel conduit.
- B. IMC: Intermediate metal conduit.

1.04 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.05 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Qualification Data: For professional engineer.
- C. Seismic Qualification Data: Certificates, for enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 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.
 - 4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.
- D. Source quality-control reports.

PART 2 PRODUCTS

2.01 METAL CONDUITS AND FITTINGS

- A. Metal Conduit:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Allied Tube & Conduit; a part of Atkore International.

- b. Calconduit.
- c. Thomas & Betts Corporation; A Member of the ABB Group.
- d. Western Tube and Conduit Corporation.
- e. Wheatland Tube Company.
- 2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 3. GRC: Comply with ANSI C80.1 and UL 6.
- 4. IMC: Comply with ANSI C80.6 and UL 1242.
- 5. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - a. Comply with NEMA RN 1.
 - b. Coating Thickness: 0.040 inch, minimum.
- 6. EMT: Comply with ANSI C80.3 and UL 797.
- B. Metal 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. Allied Tube & Conduit; a part of Atkore International.
 - b. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - c. Thomas & Betts Corporation; A Member of the ABB Group.
 - d. Western Tube and Conduit Corporation.
 - e. Wheatland Tube Company.
 - 2. Comply with NEMA FB 1 and UL 514B.
 - 3. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 4. Fittings, General: Listed and labeled for type of conduit, location, and use.
 - 5. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
 - 6. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Setscrew.
 - 7. 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.
 - 8. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.02 NONMETALLIC CONDUITS AND FITTINGS

- A. Nonmetallic Conduit:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Anamet Electrical, Inc.
 - b. CANTE INC.
 - c. Kraloy.
 - d. Thomas & Betts Corporation; A Member of the ABB Group.
 - 2. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 3. ENT: Comply with NEMA TC 13 and UL 1653.
 - 4. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
 - 5. LFNC: Comply with UL 1660.

- B. Nonmetallic 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. Anamet Electrical, Inc.
 - b. CANTE INC.
 - c. Kraloy.
 - d. RACO; Hubbell.
 - e. Thomas & Betts Corporation; A Member of the ABB Group.
 - 2. Fittings, General: Listed and labeled for type of conduit, location, and use.
 - 3. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
 - a. Fittings for LFNC: Comply with UL 514B.
 - 4. Solvents and Adhesives: As recommended by conduit manufacturer.

2.03 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 nVent.
 - 3. MonoSystems, Inc.
 - 4. Square D.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 or Type 3R unless otherwise indicated, and sized according to NFPA 70.
 - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Screw-cover type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.04 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect Prime coated, ready for field painting.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Wiremold / Legrand.
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. MonoSystems, Inc.
 - d. Panduit Corp.

2.05 BOXES, ENCLOSURES, AND CABINETS

- 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. Crouse-Hinds, an Eaton business.
 - 2. FSR Inc.
 - 3. Hoffman; a brand of nVent.
 - 4. Hubbell Incorporated.
 - 5. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - 6. Wiremold / Legrand.

- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- F. Metal Floor Boxes:
 - 1. Material: Cast metal.
 - 2. Type: Fully adjustable.
 - 3. Shape: Rectangular.
 - 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Nonmetallic Floor Boxes: Nonadjustable, round.
 - 1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- H. 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.
- I. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.
 - 1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- J. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- K. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- L. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- M. Device Box Dimensions: 4 inches square by 2-1/8 inches deep minimum.
- N. Gangable boxes are allowed.
- O. 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: Fiberglass.
 - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- P. Cabinets:
 - 1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.
 - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.06 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. <u>Manufacturers:</u> 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. Armorcast Products Company.
 - b. Oldcastle Infrastructure Inc.; CRH Americas.
 - c. Quazite; Hubbell Incorporated, Power Systems.
 - 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, "ELECTRIC.".
 - 7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 - 8. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.07 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 - 1. Tests of materials shall be performed by an independent testing agency.
 - 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 - 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 EXECUTION

3.01 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed Conduit: GRC.
 - 2. Concealed Conduit, Aboveground: GRC.
 - 3. Underground Conduit: RNC, Type EPC-40-PVC.
 - 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: EMT.
 - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 - 3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
 - a. Mechanical Room.
 - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 - 6. Damp or Wet Locations: GRC.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.

- 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
- 3. EMT: Use setscrew, fittings. Comply with NEMA FB 2.10.
- 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- G. Install surface raceways only where indicated on Drawings.

3.02 INSTALLATION

- A. Comply with requirements in Section 26 0529 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 "explosion-relief" 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 steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Complete raceway installation before starting conductor installation.
- G. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- H. 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.
- I. 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.
- J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- K. Support conduit within 12 inches of enclosures to which attached.
- L. 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 RNC, Type EPC-40-PVC, before rising above floor.
- M. 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.
- N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

- O. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- P. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- Q. 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.
- R. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- S. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- T. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- U. 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.
- V. Surface Raceways:
 - 1. Install surface raceway with a minimum 2-inch radius control at bend points.
 - Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- W. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
 - . 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.
 - Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- Z. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
 - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s)

that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.

- 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
- 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- AA. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 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.
 - 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- BB. 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.
- CC. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- DD. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- EE. Locate boxes so that cover or plate will not span different building finishes.
- FF. 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.
- GG. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- HH. Set metal floor boxes level and flush with finished floor surface.
- II. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.03 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 Division 31 for pipe less than 6 inches in nominal diameter.
 - 2. Install backfill as specified in Division 31.
 - 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 Division 31.
 - 4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
 - 5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
 - b. 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.
 - 6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.

7. Underground Warning Tape: Comply with requirements in Section 26 0553 – Identification for Electrical Systems.

3.04 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, below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.05 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 26 0544 – Sleeves and Sleeve Seals for Electrical Raceways and Cabling.

3.06 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Division 07.

3.07 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

SECTION 26 0548

SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Restraint channel bracings.
 - 2. Restraint cables.
 - 3. Seismic-restraint accessories.
 - 4. Mechanical anchor bolts.
 - 5. Adhesive anchor bolts.
- B. Related Requirements:
 - 1. Section 26 05 29 Hangers and Supports for Electrical Systems for commonly used electrical supports and installation requirements.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
- B. Delegated-Design Submittal:
 - 1. Include design calculations and details for selecting seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 2. Design Calculations: Provide design calculations to verify that seismic and wind load restraint will comply with the Oregon Structural Specialty Code for the site and the building type listed.
 - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
 - 3. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
 - d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.04 INFORMATIONAL SUBMITTALS

- A. Provide three copies of the seismic restraint system Engineer's inspection report.
- B. Provide a written authorization letter from the seismic restraint Engineer authorizing a representative to provide the inspection if a designated representative is used. Describe the representative's qualifications.

1.05 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel."
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis. They shall bear anchorage preapproval from OSHPD in addition to preapproval, showing maximum seismic-restraint ratings, by ICC-ES or another agency acceptable to authorities having jurisdiction. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) that support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- D. Comply with NFPA 70.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Provide seismic and wind load design in accordance with current Oregon State Structural Specialty Code and ASCE/SEI 7.
- B. Refer to structural notes for project specific seismic requirements.
- C. Risk Category: I
- D. Component Importance Factors (Ip)
 - 1. All components lp 1.0

2.02 RESTRAINT CHANNEL BRACINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Atkore International (Unistrut).
 - 2. Eaton (B-line).
 - 3. Hilti, Inc.
 - 4. Mason Industries, Inc.
- B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.03 RESTRAINT CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Gripple Inc.
 - 2. Kinetics Noise Control, Inc.
 - 3. nVent (CADD).
 - 4. Mason Industries, Inc.
- B. Restraint Cables: ASTM A 603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.04 SEISMIC RESTRAINT ACCESSORIES

- A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.
- D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.
- E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.05 MECHANICAL ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton (B-line).
 - 2. Hilti, Inc.
 - 3. Kinetics Noise Control, Inc.
 - 4. Mason Industries, Inc.
- B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.06 ADHESIVE ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hilti, Inc.
 - 2. Kinetics Noise Control, Inc.
 - 3. Mason Industries, Inc.
- B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods caused by seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.03 SEISMIC RESTRAINT DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Division 03.
- B. Equipment and Hanger Restraints:
 - 1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- F. Drilled-in Anchors:
 - Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.04 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.05 FIELD QUALITY CONTROL

- A. After installation of seismic and vibration control devices is complete and verified as fully functional, Contractor shall notify Engineer and seismic restraint designer that equipment is ready for inspection.
- B. Seismic restraint system Engineer shall inspect the installation to verify that seismic restraints are installed and adjusted in conformance with approved shop drawings and no additional restraints are necessary based on field conditions. Alternatively, the restraint system Engineer may designate a qualified representative to provide the inspection. The representative may not be an employee of the installing Contractor or Subcontractor.
- C. Prepare inspection reports.

3.06 AD USTING

A. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

SECTION 26 0553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Raceway and Metal-Clad Cable
 - 2. Conductor, Communication and Control Cable
 - 3. Warning Labels and Signs
 - 4. Equipment Identification Nameplates
 - 5. Wiring Device Identification
 - 6. Miscellaneous Identification Products
 - 7. Pull box and junction box identification

1.03 RELATED SECTIONS

- A. Division 01, General Requirements
- B. Division 26, Electrical
- C. Section 26 0513 Medium Voltage Cables
- D. Section 26 0519 Low Voltage Electrical Power Conductors and Cables
- E. Section 26 0533 Raceways and Boxes for Electrical Systems
- F. Section 26 2413 Switchboards
- G. Section 26 2416 Panelboards
- H. Section 26 2726 Wiring Devices
- I. Section 26 2913 Motor Circuit Disconnects

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.
- B. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- 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.

2.02 RACEWAY AND METAL CLAD CABLE

- 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. Brady Corporation
 - 2. Ideal Industries, Inc.
 - 3. Marking Services, Inc.
 - 4. Seton
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible, labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- C. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant, not less than 3 mils thick by 1 inches wide; compounded for outdoor use.
- D. Underground-Line Warning Tape:
 - 1. Pigmented, bright-colored, continuous printed polyethylene tape, compounded for directburial service.
 - 2. Detectable, embedded continuous metallic strip.
 - 3. Printed legend shall indicate type of underground line.
 - 4. Not less than 3 inches wide by 4 mils thick.
 - 5. Color: Orange tape for communication and red tape for electrical installations.

2.03 CONDUCTOR, COMMUNICATION AND CONTROL CABLE

- 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. Brady Corporation
 - 2. Panduit
 - 3. Ideal Industries, Inc.
 - 4. Marking Service, Inc.
 - 5. Seton
- B. Color-Coding Conductor Tape: Colored, heavy duty, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- C. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

2.04 WARNING LABELS AND SIGNS

- 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. Brady Corporation
 - 2. Emedco
 - 3. Marking Service, Inc.
 - 4. Seton
- B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other equipment access, unless otherwise noted.

2.05 EQUIPMENT IDENTIFICATION NAMEPLATES

A. Engraved, Three-layer, Laminated Acrylic or Melamine Nameplate: Drilled or punched for mechanical fasteners. White letters on black background, except emergency equipment nameplates shall have white letters on red background. Beveled edges with minimum letter height of 1/2-inch unless otherwise noted.

2.06 WIRING DEVICE IDENTIFICATION

A. Self-adhesive vinyl labels, machine printed with black 1/8-inch-high text on clear background, except emergency wiring devices shall have black letters on red background, by thermal transfer or equivalent process.

2.07 MISCELLANEOUS IDENTIFICATION PRODUCTS

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

PART 3 EXECUTION

3.01 PREPARATION

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

3.02 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. Labeling shall be reviewed and approved by the Owner's Authorized Representative.
- 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. 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.
- H. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- 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. System legends shall be as follows:
 - 1. "EMERGENC POWER."
 - 2. "POWER."
 - 3. "UPS."
- L. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
- M. Self-Adhesive Labels:
 - 1. On each item, 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.

- N. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- O. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- P. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- Q. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
 - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- R. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- S. 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 or concrete envelope exceeds 16 inches overall.
 - 2. Install underground-line warning tape for direct-buried cables and cables in raceways.
- T. 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.
- U. 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 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.
- V. Laminated Acrylic or Melamine Plastic 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 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

3.03 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. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil. Stencil legend "DANGER - CONCEALED HIGH-VOLTAGE WIRING" with 3-inch-high, black letters on 20-inch centers.
 - 1. Locate identification at changes in direction, at penetrations of walls and floors, and at 10foot maximum intervals.
- D. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.
 - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

- E. 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. System legends shall be as follows:
 - 1. "EMERGENC POWER."
 - 2. "POWER."
 - 3. "UPS."
 - 4. "FIRE ALARM"
- F. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use identification specified herein. Identify source and circuit number of each set of conductors or other appropriate number or letter to facilitate future troubleshooting. For single conductor cables, identify phase in addition to the above. Phase identification shall be consistent throughout the system.
 - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- G. Junction Box Identification: Identify each junction box with complete system description, including system voltage, panel, and circuits contained within.
 - 1. Acceptable Identification Methods: Neat hand lettering with permanent black marker, machine printed, adhesive vinyl labels, or engraved nameplates.
 - 2. Acceptable Locations:
 - a. In concealed locations: Locate identification on outside of junction box cover.
 - b. In exposed locations: Locate identification on inside of junction box cover.
 - 3. Fire Alarm Junction Boxes: Box covers shall be painted red and labeled "FIRE ALARM" prior to installation.
- H. Power-Circuit Conductor Identification, More Than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use identification specified herein.
- I. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.
- J. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes with the conductor designation.
- K. Branch-Circuit Conductor Identification: On conductors and cables for receptacles and line voltage switches as specified herein.
- L. Wiring Device Plate Identification: Apply machine printed, self-adhesive vinyl labels at bottom center of device plate for single gang and multiple gang devices.
 - 1. Label shall provide branch circuit identification.
 - a. Example: "B-16" indicating panel "B" and circuit #16.
- M. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.
- N. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, voice, and data connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with contract documents, manufacturer's wiring diagrams, and Operation and Maintenance Manual.
- O. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- P. Concealed Raceways and Duct Banks, More Than 600 V, within Buildings: Apply floor marking tape to the following finished surfaces:
 - 1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
 - 2. Wall surfaces directly external to raceways concealed within wall.

- 3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
- Q. 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. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- R. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Apply Baked-enamel warning signs. Identify system voltage with black letters on an orange background.
 - 1. Apply to exterior of door, cover, or other access.
 - 2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
 - a. Power-transfer switches.
 - b. Controls with external control power connections.
- S. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- T. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.
- U. Equipment Identification Labels:
 - 1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
 - 2. Outdoor Equipment: Laminated acrylic or melamine sign.
 - 3. Install nameplates for equipment, including but not limited to, the following:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of an engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchgear.
 - e. Switchboards.
 - f. Transformers: Label that includes tag designation indicated on contract documents for the transformer, primary source, secondary load and location.
 - g. Substations.
 - h. Emergency system boxes and enclosures.
 - i. Motor-control centers.
 - j. Disconnect switches.
 - k. Enclosed circuit breakers.
 - I. Enclosed controllers.
 - m. Variable-speed controllers.
 - n. Push-button stations.
 - o. Power-transfer equipment.
 - p. Contactors.
 - q. Battery-inverter units.
 - r. Battery racks.
 - s. Power-generating units.
 - t. Monitoring and control equipment.
 - u. UPS equipment.
 - 4. Provide the following information on each nameplate:
 - a. Equipment name/tag:
 - 1) Matching the designation indicated on the contract documents, or identifying the load controlled or function of the equipment where no specific tag is shown on the contract documents unless otherwise noted.

- b. Equipment operating voltage, phase, wiring configuration and ampacity
 1) Example: 480V/3PH/4W/225A
- c. Source of power supply, including circuit number:
 - 1) Example: FED FROM 4NL1-3
- V. At service entrance equipment, provide a nameplate identifying the maximum available fault current and "as of" effective date.

END OF SECTION

SECTION 26 0572

OVERCURRENT PROTECTIVE DEVICE SHORT CIRCUIT AND ARC FLASH STUDY

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 RELATED SECTIONS

- A. Section 26 24 13 Switchboards
- B. Section 26 24 16 Panelboards
- C. Section 26 28 16 Overcurrent Protective Devices
- D. Section 26 29 13 Motor and Circuit Disconnects

1.03 SUMMARY

- A. This Section includes computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study. The short-circuit and overcurrent protective device coordination study shall be approved by the Engineer prior to the ordering of switchboards, panelboards, enclosed circuit breakers, disconnect switches, transfer switches, and overcurrent protective devices.
- B. Acceptable Software Manufacturers:
 - 1. SKM
 - 2. Easy Power
 - 3. ETAP
- C. The above manufacturers are known to be acceptable for study purposes. However, at the completion of the project an electronic SKM file of the study must be provided to the Owner. The file shall include all files required to edit and evaluate the electronic model, including libraries, one-lines, scenarios, TCC curves and all reports.
- D. Each project shall have a unique building identifier for every named component created in the electronic one-line diagram. This unique identifier will allow for incorporation of the final model into the SKM model. Coordinate with the Owner for the unique building identifier to be used for the project.

1.04 SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.
- C. Other Action Submittals:
 - 1. Coordination-study input data.
 - 2. Study and Equipment Evaluation Reports.
 - 3. Coordination-Study Report.

1.05 QUALITY ASSURANCE

- A. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.
- B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
- 1. Professional engineer, with a minimum of five years of experience and licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.
- 2. Study shall be performed by specified equipment manufacturer.
- C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.
- D. Comply with IEEE and IEEE 1584 for general study procedures.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance.
 - 1. Proceed with coordination study only after a bill-of-material including the electrical distribution system protective devices has been assembled.

3.02 POWER SYSTEM DATA

- A. Gather and tabulate the following input data to support coordination study:
 - 1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Available fault current at the primary terminals of the building transformer(s).
 - 3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
 - a. Circuit-breaker ratings and types.
 - b. Relays and associated power and current transformer ratings and ratios.
 - c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and /R ratios.
 - d. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
 - e. Busway ampacity and impedance.
 - f. Motor horsepower and code letter designation according to NEMA MG 1.
 - 4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - d. Generator thermal-damage curve.
 - e. Ratings, types, and settings of utility company's overcurrent protective devices.
 - f. Time-current-characteristic curves of devices indicated to be coordinated.
 - g. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
 - h. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
 - i. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.03 SHORT CIRCUIT STUDY

- A. Contact Utility for starting fault.
- B. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuitbreaker positions in the electrical power distribution systems. The calculations shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
 - 1. Switchgear and switchboard buses.
 - 2. Medium-voltage buses.
 - 3. Motor-control centers.
 - 4. Distribution panelboards.
 - 5. Branch circuit panelboards.
 - 6. Electrical utility supply termination point.
- C. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project down to the smallest protective device. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- D. The Short-Circuit study and the coordination study shall be performed with the aid of a computer program and shall be in accordance with IEEE 399.
- E. Include motor contribution in study with /R ratio of 0.17. Do not include motor contribution when motors are fed from variable frequency drives.
- F. Calculate momentary and interrupting duties based on maximum available fault current.
- G. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 242.
 - 1. Transformers:
 - a. ANSI C57.12.10.
 - b. ANSI C57.12.22.
 - c. ANSI C57.12.40.
 - d. IEEE C57.12.00.
 - e. IEEE C57.96.
 - 2. Medium-Voltage Circuit Breakers: IEEE C37.010.
 - 3. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
- H. Study Report:
 - 1. Show calculated /R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
 - 2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on mediumvoltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.
- I. Equipment Evaluation Report:
 - 1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
 - 2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
 - 3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.04 COORDINATION STUDY

- A. Perform coordination study with the aid of a computer program. Prepare a written report using results of Short-Circuit study. Comply with IEEE 399.
 - 1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.

- 2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
- 3. Calculate the maximum and minimum ground-fault currents.
- 4. Study to include emergency, standby and normal power systems.
- B. The coordination study shall determine the correct settings for the protective devices which will minimize the damage caused by an electrical fault. Selective coordination shall be shown by the study between devices supplying the following systems:
 - 1. Life Safety (emergency) system: Coordinated to 0.01 seconds.
 - 2. Optional Standby system: Coordinated to 0.02 seconds.
 - 3. Normal system: Coordinated to 0.1 seconds.
 - 4. The coordination study shall consider operation during normal conditions, alternate operation, and during emergency power conditions.
- C. The coordination study shall include the overcurrent protective devices in all low voltage classes of equipment including, switchgear and switchboard buses, distribution panelboard buses, and branch circuit panelboard buses. The coordination study shall also include the closest upstream medium voltage overcurrent protective device.
- D. Comply with IEEE 242 recommendations for fault currents and time intervals.
- E. Transformer Primary Overcurrent Protective Devices:
 - Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
 - 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
- F. Motors served by voltages more than 600 V shall be protected according to IEEE 620.
- G. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- H. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
 - 1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
 - a. Device tag.

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- b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
- c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
- d. Ground-fault relay-pickup and time-delay settings.
- 2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
 - a. Device tag.
 - b. Voltage and current ratio for curves.
 - c. Three-phase and single-phase damage points for each transformer.
 - d. Cable damage curves.
 - e. Transformer inrush points.
 - f. Maximum fault-current cutoff point.

3.05 ARC FLASH HAZARD ANALYSIS

- A. Provide an Arc Flash Hazard Study per the requirements set forth in NFPA 70E. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E.
- B. Arc flash study to determine:
 - 1. Arc flash incident energies.
 - 2. Arc flash boundaries.
 - 3. Shock hazard boundaries
 - 4. Personal protective equipment (PPE) for energized electrical equipment.
- C. Arc flash study shall provide following information for each system mode of operation and shall be documented. The study results shall include:
 - 1. Equipment name and voltage.
 - 2. Equipment device name and ANSI function (i.e. 51/50).
 - 3. Equipment type, i.e., switchgear, MCC, panel, VFD, medium voltage transformers, etc.
 - 4. Equipment arc gap.
 - 5. Bolted and estimated arcing fault current at the fault point (equipment) in symmetrical amperes. The estimated arcing current should be based on the arcing current equations used.
 - 6. Trip time, opening time, and total clearing time (total Arc time) of the protective device.
 - 7. Worst-case arc flash boundary for each bus/equipment in the model.
 - 8. Worst-case arc flash hazard incident energy in cal/cm2 for each bus/equipment in the model.
 - 9. Worst-case personal protective equipment (PPE) for each bus/equipment in the model.
 - 10. Working distances for up to five different distances showing items g, h, and i for each distance.
 - 11. Indicate "Danger/Hazardous" areas where incident energy is greater than 40 cal/cm2 and provide recommendations to reduced arc flash energy levels for these areas.
 - 12. Flag results where 85% arcing current provided worst-case results.
- D. Arc flash study report format:
 - 1. Introduction.
 - 2. Methodology.
 - 3. Back up information.
 - 4. Key assumptions.
 - 5. IEEE 1584-2018 considerations.
 - 6. Arc flash reduction options: Overcurrent protective device changes.
 - 7. Explanation of data in arc flash hazard report tables.
 - 8. NFPA 70E Information.
 - a. Shock hazards with covers removed.
 - b. Shock hazard approach boundaries.
 - 1) Limited approach boundary.
 - 2) Restricted approach boundary.
 - c. Arc flash hazard boundaries.
 - 9. Results of arc flash hazard analysis for high voltage, medium voltage and low voltage systems, including:
 - a. Working distances.
 - b. Energy levels.
 - c. PPE requirements.
 - d. Recommendations to reduce arc flash hazard energy and exposure.
 - 10. Arc flash hazard report.
 - 11. Electronic file compatible with SKM program.
- E. Provide labels for the project.
- F. The Arc Flash study must be completed prior to energizing any medium voltage transformers.

3.06 SETTINGS AND AD USTMENT

- A. Set and adjust all breakers in the distribution system per the recommendations of the coordination study and settings table.
- B. Provide protective covers and locking devices on breakers to secure settings from accidental changes.
- C. Final settings shall be witnessed by Owner's Authorized Representative. The contractor shall remove all covers that obscure any adjustable trip settings. Witnessing shall be completed with the equipment de-energized. The contractor is responsible for notifying the Owner when they are ready for the witnessing to occur.

3.07 ARC FLASH WARNING LABELS

- A. Provide a 4-inch x 4-inch thermal transfer type label of high adhesion polyester for each work location analyzed.
- B. All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the Owner and after any system changes, upgrades or modifications have been incorporated in the system.
- C. The label shall include the following information, at a minimum:
 - 1. Location designation.
 - 2. Nominal voltage
 - 3. Flash protection boundary
 - 4. Incident energy
 - 5. Working distance
 - 6. Engineering report number, revision number and issue date.
 - 7. Available fault current based on the most recent study.
 - 8. NFPA 70E reference to appropriate PPE.
- D. Labels shall be machine printed, with no field markings.
- E. One Arc flash label shall be provided for each, medium voltage transformer primary and secondary, switchboard, switchgear section, motor control center, panelboard and busway.
 - 1. Floor Standing Equipment: Labels shall be provided on the front of each individual section. Equipment requiring rear and/or side access shall have labels provided on each individual section access area. Equipment line-ups containing sections with multiple incident energies and flash protection boundaries shall be labeled as identified in the Arc Flash Analysis table.
 - 2. Wall Mounted Equipment: Labels shall be provided on the outside of the front cover, centered at the top.
- F. Labels shall be installed on equipment prior to Substantial Completion.
 - 1. Labels shall be mounted on the outside of the front cover, centered at the top.
- G. The overall color, top and bottom, of the arc flash hazard label shall very depending upon the incident energy level range as follows:
 - 1. ELLOW: 8 cal/cm2
 - 2. TAN: 8 ≤ 12 cal/cm2
 - 3. ORANGE:12 \leq 25 cal/cm2
 - 4. MAGENTA: $25 \le 40$ cal/cm2
 - 5. RED: ≥ 40 cal/cm2

END OF SECTION

SECTION 26 0800

COMMISSIONING OF ELECTRICAL

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes Commissioning activities required for work of Division 26 Sections including but not limited to construction checks, equipment start-up, functional testing, and operator training.
 - 1. Comply with Section 01 91 13 General Commissioning Requirements for Commissioning activities for Division 26 work.

1.02 SEQUENCING

- A. Provide written notification to Commissioning Provider (CxP) in advance of significant project dates including but not limited to the following:
 - 1. Two weeks prior to Manufacturer's start-up of lighting control system.
 - 2. Two weeks prior to Manufacturer's start-up of generator.

1.03 SUBMITTALS

- A. Provide submittals of systems being commissioned to Owner's Authorized Representative as required by Section 01 91 13.
- B. Contractor to provide electronic copies of work products and other items as specified to support development of commissioning documentation. Refer to Section 01 91 13 for specific submittal requirements.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Manufacturer's representative to perform construction checks and operational training as specified in Division 26 including the following systems:
 - 1. Emergency Power Supply System
 - 2. Lighting Control System

3.02 LIGHTING CONTROL VERIFICATION REPORT

- A. Control Contractor shall perform construction checks, start-up, and verification of automatic lighting control system. Provide verification report demonstrating proper system installation and operation. Verification shall include the following:
 - 1. Equipment Startup: All equipment being controlled shall be initially started and tested as required by the manufacturer. All required manufacturer installation and start-up checklists shall be attached to the construction checklists.
 - 2. Communication Network Startup: Verify that all lighting control panels properly communicate on network. Verify communication speed and reliability is acceptable.
 - 3. Software Verification: All programs and software functions shall be verified for proper sequence of operation.
 - 4. Controls Verification Report: After system operation is completely verified, provide written certification to Owner that systems have been fully tested and are operating according to specifications and ready for functional testing. Include report to the CxP detailing verification results and the dates, times and person(s) performing startup. Report shall include:
 - a. Device Calibration Log.
 - b. Lighting Relay Control Panels.
 - 1) Provide date, time, panel designation, and panel location.
 - 2) Provide a list of all programmed time schedules.

- 3) Provide a list of all sweep times, sweep control on or off, and relays that are swept off.
- 4) Provide a list of all group load assignments.
- 5) Provide all photocell control parameters and setpoints.
- 6) Provide a checkout document indicating the following:
 - a) Lighting relay panel designation.
 - b) Relay number.
 - c) Relay description.
 - d) Power circuit feeding relay.
 - e) Verified relay operation.
 - f) Verified time schedule control.
 - g) Verified sweep control.
 - h) Verified photocell control.
- c. Low Voltage Switches
 - 1) Provide a verification document indicating the following:
 - a) Switch location.
 - b) Verified switch operation.
 - c) Verified switch override operation.
- d. Occupancy Sensors
 - 1) Provide a verification document indicating the following:
 - a) Room or space designation.
 - b) Manufacturer.
 - c) Model.
 - d) Technology type.
 - e) DIP settings.
 - f) Trigger settings.
 - g) Time delay settings.
 - h) Sensitivity settings.
 - i) Verified sensor operation.
- e. Daylight Compensation Systems
 - 1) Provide a verification report indicating the following:
 - a) Provide date and time.
 - b) Room or space designation.
 - c) Manufacturer.
 - d) Model.
 - e) Light level maintained at the work plane.
 - f) Average light level with all electric lights off and no window obstruction.
 - g) Average light level with electric lights on and no window obstruction.
 - h) Average light level with electric lights on and at minimum output with no window obstruction.
 - i) Average light level with electric lights on and at maximum output with no window obstruction.
 - j) Average light level with electric lights on at maximum output at night or with windows obstructed.
 - k) Average light level with electric lights on at minimum output at night or with windows obstructed.
 - I) Provide all parameters and settings for all devices.
 - Digitally Addressable Lighting Interface Systems
 - 1) Calibration Log
 - a) Provide date, time control system readout, means of verification, verification measurement, and calibration parameters for each analog input.
 - 2) Point Summary Log

f.

- a) Attach printed log showing detailed descriptive data and configuration parameters for all points.
- 3) Operational Trend Logs: Include trend logs as follows:
 - a) Trend data for all analog and digital points.
- 1) Analog Control: Points that modulate over time shall be sampled at appropriate intervals and durations to demonstrate properly operating sequences. Provide one sample every 5 minutes for at least one week.
- Digital Control: Dual-state control or monitoring points shall be recorded as COV (change of value). A minimum of one week of samples shall be provided to properly demonstrate equipment cycles, modes, and schedules.
- 5. Demonstration: Demonstrate operation of control system to Engineer, CxP, and Owner including:
 - a. Menu functions.
 - b. Relay overrides.
 - c. Programming of relays, time schedules.

3.03 FUNCTIONAL TESTING

- A. Contractor shall perform testing as directed by Commissioning Provider and as required by Section 01 91 13. Functional Test Plans for each system being commissioned will be prepared by Commissioning Provider during construction. Provide an allowance of on-site labor hours per trade for assisting Commissioning Provider with Functional Testing as listed below. Labor required for retesting due to failure of equipment or systems to perform in accordance with Contract Documents shall be provided at no additional cost to Owner.
- B. Perform standby and emergency power system pre-test prior to functional testing. Coordinate pre-test with Division 23. Provide pre-test documentation to Commissioning Provider prior to functional testing.

3.04 SCHEDULE OF SYSTEMS BEING COMMISSIONED

- A. Commission systems and equipment listed below including associated equipment and control systems.
 - 1. Emergency and Stand-by Power System
 - 2. Automatic Lighting Control System

END OF SECTION

SECTION 26 0924

DIGITAL LIGHTING CONTROL EQUIPMENT

PART 1 GENERAL

2.

1.01 SUMMARY

- A. Section includes a networked lighting control system comprised of the following components:
 - 1. System Backbone and Integration Equipment
 - a. System Controller
 - b. Digital Time Clock
 - Wired Network Devices
 - a. Wall Stations
 - b. Auxiliary Input/Output Devices
 - c. Occupancy and Photocell Sensors
 - d. Wall Switch Sensors
 - e. Power Packs and Secondary Packs
 - f. Relay and Dimming Panel
 - g. Bluetooth Low Energy Programming Device
 - h. Communication Bridge
 - 3. The networked lighting control system shall meet all the characteristics and performance requirements specified herein.
 - 4. The contractor shall provide, install and verify proper operation of all equipment necessary for proper operation of the system specified herein and as shown on applicable drawings.

1.02 RELATED SECTIONS

- A. Section 26 2726 Wiring Devices
- B. Section 26 5100 Lighting Fixtures

1.03 REFERENCES

- A. American Nation Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE).
- B. International Organization for Standards (ISO).
- C. National Electrical Manufacturers Association (NEMA)
- D. Underwriters Laboratories, Inc. (UL)
 - 1. 916 Energy Management Equipment
 - 2. 924 Emergency Lighting and Power Equipment

1.04 SYSTEM DESCRIPTION OPERATION

- A. Control of the following areas indicated on the Drawings:
 - 1. Interior spaces without exterior windows, including but not limited to open/private offices, conference room and meeting rooms.
 - a. Lighting in spaces shall be controlled by occupancy sensors located within the space. Upon detection, lights will turn ON to 50% output and turn OFF after 20 minutes of no occupancy detection.
 - 1) Auxiliary relay in space shall provide contact closure to mechanical system for control of equipment when space is occupied. Coordinate connection with mechanical.
 - b. Override control lighting in space shall be capable of switching lighting ON/OFF and raise/lower lighting level in space.
 - c. Set high-end trim for lighting to 90% output. Verify high-end trim setting with Owner prior to programming and modify as required.
 - 2. Interior spaces with exterior windows, including, but not limited to, open/private offices, conference rooms and meeting rooms.

- a. Manual input at wall mounted control station shall be required to turn ON lighting in the space and lighting will turn OFF after 20 minutes of no occupancy detection. Set high-end trim for lighting to 90% output. Verify high-end trim setting with Owner prior to programming and modify as required.
 - 1) Auxiliary relay in space shall provide contact closure to mechanical system for control of equipment when space is occupied. Coordinate connection with Mechanical.
- b. Where daylighting zones are indicated on drawings, lighting located within zones shall be continuously dimmed according to the light level measured at the photocell within the space.
 - 1) Target footcandle level at **+30**" AFF in daylighting zone shall be **30** fc. Verify target light level with Owner prior to programming and modify as required.
- c. Override control of lighting in space shall be capable of switching lighting ON/OFF and raise/lower lighting level within space.
- 3. Enclosed Stairwells
 - a. Lighting in stairwells shall be illuminated at all times to 50% output.
 - b. Lighting shall be controlled by occupancy sensors located within stairwells and raise lighting to full output upon detection and return to 50% output after 15 minutes of no occupancy detection.
- 4. Corridors and other Circulation areas, excluding enclosed stairwells
 - a. Normally Occupied Hours:
 - Scheduled operation shall turn lights ON in area to 30% output. Upon occupancy detection, lighting output shall increase to 90% output and return to 30% after 15 minutes of no occupancy detection. Verify high-end trim with Owner prior to programming and modify as required.
 - a) Time schedule operation shall be lights ON at 6AM / OFF at 6PM. Verify schedule with Owner prior to programming and modify as required.
 - 2) Where daylighting zones are indicated on drawings, lighting located within zones shall be continuously dimmed according to the light level measured at the photocell within the space.
 - a) Target footcandle level in at **30**" AFF in daylighting zones shall be **15** fc . Verify target light level with Owner prior to programming and modify as required.
 - b. Normally Unoccupied Hours:
 - Lighting in zone will be controlled by local occupancy sensors located within the zone. Upon detection lights will turn ON to 90% output and turn OFF after 15 minutes of no occupancy detection. Verify high-end trim with Owner prior to programming and modify as required.
 - c. Lighting in circulation areas shall remain ON at 30% output when occupancy is detected in any space within the building, including but not limited to, Break rooms, Conference and Meeting rooms, Open and Private Offices
- 5. Interior spaces without exterior windows, including but not limited to Conference rooms, Meeting rooms, and Private Offices.
 - a. Lighting in spaces shall be controlled by occupancy sensors located within the space. Upon detection, lights will turn ON to 50% output and turn OFF when occupancy is no longer detected.
 - 1) Auxiliary relay in space shall provide contact closure to mechanical system for control of mechanical equipment when space is occupied. Coordinate connection with Mechanical.
 - b. Override control of lighting in space shall be capable of switching lighting ON/OFF and raise/lower lighting level within space.
 - c. Set high-end trim for lighting to 90% output. Verify high-end trim setting with Owner prior to programming and modify as required.
- 6. Perimeter spaces with exterior windows, including but not limited to Conference rooms, Meeting rooms, and Private Offices.

- a. Manual input at wall mounted control station shall be required to turn ON lighting in the space and lighting will turn OFF when occupancy is no longer detected. Set highend trim for lighting to 90% output. Verify high-end trim setting with Owner prior to programming and modify as required.
 - 1) Auxiliary relay in space shall provide contact closure to mechanical system for control of mechanical equipment when space is occupied. Coordinate connection with Mechanical.
- b. Where daylighting zones are indicated on drawings, lighting located within zones shall be continuously dimmed according to the light level measured at the photocell within the space.
 - 1) Target footcandle level at +30" AFF in daylighting zones shall be 30 fc. Verify target light level with Owner prior to programming and modify as required.
- c. Override control of lighting in space shall be capable of switching lighting ON/OFF and raise/lower lighting level within space.
- 7. Corridors, Stairs and other Circulation areas
 - a. Normally Occupied Hours:
 - Scheduled operation shall turn lights ON in area to 30% output. Upon occupancy detection, lighting output shall increase to 90% output and return to 30% when occupancy is no longer detected. Verify high-end trim with Owner prior to programming and modify as required.
 - a) Time schedule operation shall be lights ON at 6AM / OFF at 6PM. Verify schedule with Owner prior to programming and modify as required.
 - 2) Where daylighting zones are indicated on drawings, lighting located within zones shall be continuously dimmed according to the light level measured at the photocell within the space.
 - a) Target footcandle level in at 30" AFF in daylighting zones shall be 20 fc. Verify target light level with Owner prior to programming and modify as required.
 - b. Normally Unoccupied Hours:
 - Lighting in zone will be controlled by local occupancy sensors located within the zone. Upon detection lights will turn ON to 90% output and turn OFF when occupancy is no longer detected. Verify high-end trim with Owner prior to programming and modify as required.
 - c. Lighting in circulation areas shall remain ON at 30% output when occupancy is detected in any space within the building, including but not limited to, Break rooms, Conference rooms, Open and Private Offices
- 8. Open spaces that are open to corridors, including but not limited to, Break rooms and Open Office.
 - a. Normally Occupied Hours:
 - Scheduled operation shall turn lights ON in area to 30% output. Upon occupancy detection, lighting output shall increase to 90% output and return to 30% when occupancy is no longer detected. Verify high-end trim with Owner prior to programming and modify as required.
 - a) Time schedule operation shall be lights ON at 6AM / OFF at 6PM. Verify schedule with Owner prior to programming and modify as required.
 - 2) Where daylighting zones are indicated on drawings, lighting located within zones shall be continuously dimmed according to the light level measured at the photocell within the space.
 - a) Target footcandle level in at 30" AFF in daylighting zones shall be 30 fc. Verify target light level with Owner prior to programming and modify as required.
 - b. Normally Unoccupied Hours:
 - Lighting in zone will be controlled by local occupancy sensors located within the zone. Upon detection lights will turn ON to 90% output and turn OFF when occupancy is no longer detected. Verify high-end trim with Owner prior to programming and modify as required.

- c. Override control of lighting in space shall be capable of switching lighting ON/OFF and raise/lower light level within the space.
- d. Auxiliary relay in space shall provide contact closure to mechanical system for control of mechanical equipment when space is occupied. Coordinate connection with Mechanical.
- 9. Exterior Canopy Lights & Building-Mounted Lights
 - a. Lighting shall be controlled by relay panel and programmable astronomical time clock, unless otherwise noted.
 - 1) Lighting shall turn ON to full output at dusk
 - 2) Lighting output shall reduce to 50% at 11PM and return to full output at 5AM.
 - 3) Lighting shall turn OFF at dawn.
 - 4) Verify schedule and output levels with Owner prior to programming and modify as required.
- 10. Site Lighting
 - a. Lighting shall be photocell and occupancy sensor controlled by fixture mounted photocell and occupancy sensor.
 - 1) Lighting shall turn ON at dusk to 40% output. Upon detection of motion, lighting shall raise to full output, and return to 40% output after occupancy sensor timeout period.
 - a) Timeout period for sensors shall be 15 minutes. Confirm timeout period with Owner prior to programming and modify as required.
 - 2) Fixtures shall operate in Groups indicated on drawings, where any detection at any sensor in a group will raise the lighting level of all fixtures with that group.
- 11. Remaining areas that are not indicated above are intended to have standalone control utilizing digital lighting control components unless otherwise noted.
 - a. These areas shall have auto ON/auto OFF control of lighting using local switches and occupancy sensors within their respective spaces, unless otherwise noted.
 - b. Occupancy sensors in remaining areas shall have a timeout period of 20 minutes.

1.05 ACTION SUBMITTALS

- A. Submittals prior to commencing Work:
 - 1. Submit in accordance with Div. 01 within 6 weeks of project award.
 - 2. When Manufacturers' product information applies to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the pertinent specification or drawing.
 - 3. Control System Hardware:
 - a. Provide a complete bill of materials of control system hardware indicating quantity, manufacturer, model number, and technical data. Technical data shall include performance curves, product specifications sheets, and installation maintenance instructions.
 - b. Network Communication Diagrams: Provide schematic diagram showing all components, communications cabling, and termination points. Identify power requirements and power source for each device. Identify equipment each device is controlling. Show termination numbers.
 - c. Provide plans indicating locations of all control hardware.
 - d. Hardware and Software Operation Manuals and any software required for updates or changes to the system.
 - e. Provide digital copies of programming manuals for each configurable device furnished.
 - 4. Controlled Systems:
 - a. Provide an instrumentation list for each control zone including all controlled system elements in table format. Tables to show element name, type of device, manufacturer, model number, and product data sheet number.
 - b. Provide a schematic wiring diagram for each controlled system. Label all elements. Label all terminals.

- c. Provide a mounting, wiring, and routing plan-view drawing.
- d. Provide a complete description of all devices for each control zone including sequence of operation and configuration parameters.
- e. Start-up and Verification: Provide example Contractor Startup and Verification Worksheet.
- f. Submittal name and certification for Manufacturers Field Start-up Technician.
- B. Closeout Submittals
 - 1. Fully executed Contractor Startup and Verification Worksheet demonstrating system installation and operation in accordance with requirements specified herein. Worksheet must be submitted prior to Substantial Completion.
 - 2. Record documents shall include the following.
 - a. Project record drawings. Project record drawings will be as-built versions of the Shop Drawings in digital PDF format.
 - b. Provide copy of approved start-up and verification worksheets.

1.06 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Digital Occupancy Sensors: Equal to 3 of each type of sensor used on project.
 - 2. Digital Wall Switch: Equal to 3 of each type of switch used on project.
 - 3. Bridges/Gateways: Equal to two percent of amount installed, but no fewer than.
 - 4. Digital Power Packs: Equal to 5 of each type of power pack used on project.

1.07 QUALITY ASSURANCE

- A. Product Qualifications
 - 1. System electrical components shall be listed or recognized by a national recognized testing laboratory (e.g., UL, ETL, or CSA) and shall be labeled with required markings as applicable.
 - 2. System shall be listed as qualified under DesignLights Consortium Networked Lighting Control System Specification V4.0.
 - 3. System luminaires and controls are certified by manufacturer to have been designed, manufactured and tested for interoperability.
 - 4. All components shall be subjected to 100% end of line testing prior to shipment to the project site to ensure proper device operation.
 - 5. All components and the manufacturing facility where product is manufactured must be RoHS compliant.
- B. Installation and Startup Qualifications
 - 1. System startup shall be performed by qualified personnel approved or certified by the manufacturer.
- C. Service and Support Requirements
 - 1. Phone Support: Toll free technical support shall be available.
 - 2. Remote Support: The bidder shall offer a remote support capability.
 - 3. Onsite Support: The bidder shall offer onsite support that is billable at whole day rates.
 - 4. Service Contract: The bidder shall offer a Service Contract that packages phone, remote, and onsite support calls for the project. Response times for each type of support call shall be indicated in the terms of the service contract included in the bid package.

1.08 COORDINATION

- A. Coordinate lighting control components to form an integrated interconnection of compatible components.
- B. Coordinate lighting controls with Building Automation System through hardwired auxiliary relay outputs. Reference mechanical drawings for equipment requiring.
- C. The installing contractor shall be responsible for a complete and functional system in accordance with all applicable local and national codes.

1.09 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Software: Failure of input and output to execute switching or dimming commands.
 - b. Failure of modular relays to operate under manual or software commands.
 - c. Damage of electronic components due to transient voltage surges.
 - 2. Warranty Period:
 - a. For Control Hardware Components: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. nLight Network Control System Basis of Design.
- B. Wattstopper Digital Lighting Management (DLM) System.
- C. Or approved equivalent.

2.02 SYSTEM REQUIREMENTS

- A. System shall have an architecture that is based upon three main concepts:
 - 1. Intelligent lighting control devices.
 - 2. Standalone lighting control zones.
 - 3. Network backbone for remote or time-based operation.
- B. Intelligent lighting control devices shall consist of one or more basic lighting control components; occupancy sensors, photocell sensors, relays, dimming outputs, manual switch stations, and manual dimming stations. Combining one or more of these components into a single device enclosure should be permissible so as to minimize overall device count of system.
- C. Where required the system must interface directly with intelligent LED luminaires such that only CAT-5/6 cabling is required to interconnect luminaires with control components such as sensors and switches.
- D. Intelligent lighting control devices shall communicate digitally, require 4mA of current to function (Graphic WallPod excluded), and possess at least two RJ-45 connectors.
- E. Lighting control zones shall consist of one or more intelligent lighting control components, be capable of stand-alone operation, and be capable of being connected to a higher-level network backbone.
- F. Devices within a lighting control zone shall be connected with CAT-5/6 low voltage cabling, in a daisy-chain fashion, and in any order.
 - 1. Provide Orange thermoplastic jacket color for category cabling serving digital lighting control equipment. Confirm jacket color with Owner prior to installation.
- G. Lighting control zone shall be capable of automatically configuring itself for default operation without any start-up labor required.
- H. Individual lighting zones must continue to provide a user defined default level of lighting control in the event of a system communication failure with the backbone network or the management software becoming unavailable.
- I. Power for devices within a lighting control zone shall come from either resident devices already present for switching (relay device) or dimming purposes, or from the network backbone. Standalone "bus power supplies" shall not be required in all cases.
- J. All switching and dimming for a specific lighting zone shall take place within the devices located in the zone itself (i.e. not in a remotely located devices such as panels) to facilitate system robustness and minimize wiring requirements. Specific applications that require centralized or remote switching shall be capable of being accommodated.
- K. System shall have a primary wall mounted network control "gateway" device that is capable of accessing and controlling connected system devices and linking into an Ethernet LAN.

- L. System shall use "bridge" devices that route communication and distribute power for up to 8 lighting zones together for purposes of decreasing system wiring requirements.
- M. System shall have a web-based software management program that enables remote system control, status monitoring, and creation of lighting control profiles.
- N. Individual lighting zones shall be capable of being segmented into several channels of occupancy, photocell, and switch functionality for more advanced configurations and sequences of operation.
- O. Devices located in different lighting zones shall be able to communicate occupancy, photocell, and switch information via the wired backbone.
- P. System shall be capable of operating a lighting control zone according to several sequences of operation. Note operating modes should be utilized only in manners consistent with local energy codes.
 - 1. Auto-On / Auto-Off (via occupancy sensors)
 - a. Zones with occupancy sensors automatically turn lights on when occupant is detected.
 - b. Zones with occupancy and/or photocell sensors turn lights off or dim when vacancy or sufficient daylight is detected.
 - c. Pressing a switch will turn lights off. The light will remain off regardless of occupancy until switch is pressed again, restoring the sensor to Automatic On functionality.
 - 2. Manual-On / Auto-Off.
 - a. Pushing a switch will turn lights on.
 - b. Zones with occupancy and/or photocell sensors turn lights off or dim when vacancy or sufficient daylight is detected.
 - 3. Manual-On to Auto-On / Auto-Off
 - a. Pushing a switch will turn lights on.
 - b. After initial lights on, zones with occupancy and/or photocell sensors turn lights on/off or dim according to occupancy/vacancy and/or daylight conditions.
 - c. Sequence can be reset via scheduled (ex. daily each morning) events.
 - 4. Auto-to-Overdrive On.
 - a. Zones with occupancy sensors automatically turn lights on when occupant is detected.
 - b. Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.
 - c. Sequence can be reset via scheduled (ex. daily each morning) events.
 - 5. Manual-to-Overdrive On.
 - a. Pushing a switch will turn lights on.
 - b. Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.
 - c. Sequence can be reset via scheduled (ex. daily each morning) events.
 - 6. Auto-On / Predictive Off.
 - a. Zones with occupancy sensor automatically turn lights on when occupant is detected.
 - b. Zones with occupancy and/or photocell sensors turn lights off or dim when vacancy or sufficient daylight is detected.
 - c. If switch is pressed, lights turn off and a short "exit timer" begins. After time expires, sensor scans the room to detect whether occupant is still preset. If no occupancy is detected, zone returns to auto-on. If occupancy is detected, light must be turned on via the switch
 - 7. Multi-Level On (multiple lighting levels per manual button press).
 - a. Operating mode designed specifically for bi-level applications.
 - b. Enables the user to cycle through the up to four potential on/off lighting states using a single button.
 - c. Eliminates user confusion as to which of two buttons controls which load.
 - d. Three different transition sequences are available in order to comply with energy codes or user preferences.

- e. In addition to achieving bi-level lighting control by switching loads with relays, the ability to command dimming outputs to "step" in a sequence that achieves bi-level operation is present.
- Q. A taskbar style desktop application shall be available for personal lighting control.
- R. An application that runs on "smart" handheld devices (such as smart phones) shall be available for personal lighting control.
- S. Control software shall enable logging of system performance data and presenting useful information in a web-based graphical format and downloadable to .CSV files.
- T. Control software shall enable integration with a BMS via BACnet IP.
- U. System shall provide the option of having pre-terminated plenum rated CAT-5/6 cabling supplied with hardware.

2.03 SYSTEM BACKBONE EQUIPMENT

- A. System Controller
 - 1. Product Series: nEC , or approved Wattstopper DLM equivalent.
 - 2. System Controller shall be multi-tasking, real-time digital control processor consisting of modular hardware with plug-in enclosed processor, communication controllers, and power supplies.
 - 3. System Controller shall have minimum of 512MB memory, with a minimum of 4GB non-volatile flash, to support its own operating system and database.
 - 4. System Controller shall perform the following functions:
 - a. Time-based control of downstream wired and wireless network devices.
 - b. Linking into an Ethernet network.
 - c. Integration with Building Management Systems (BMS) and Heating, Ventilation and Air Conditioning (HVAC) equipment.
 - d. Connection to various software interfaces
 - 5. System Controller shall have an integral web server to support configuration, diagnostics and hosting of software interfaces.
 - 6. Device shall have option for a graphical touch screen to support configuration and diagnostics.
 - 7. Device shall have three RJ-45 networked lighting control ports for connection to any of the following:
 - a. The graphical touchscreen
 - b. Wired communication bridges
 - c. Direct connection to networked wired luminaires and intelligent lighting control devices (up to 128 total devices per port).
 - 8. Device shall automatically detect all networked devices connected to it.
 - 9. Device shall have an internal time clock used for astronomical and standard schedules.
 - 10. Device shall have 2 switched RJ-45 10/100 BaseT Ethernet ports for local area network (LAN) connection.
 - a. Ethernet connection shall support daisy chain wiring to other lighting control system LAN devices.
 - b. Ethernet connection shall support IPv4 and shall be capable of using a dedicated static or DHCP assigned IP address.
 - 11. Device shall have 2 x USB 2.0 Expansion ports for 802.11 Wi-Fi Adapter enabling wireless connectivity including:
 - a. Hot Spot
 - b. Access Point
 - c. Client
 - 12. Each System Controller shall be capable of managing and operating at least 750 networked devices (wired or wireless).
 - 13. System Controller shall support BACnet/IP and BACnet MS/TP protocols to directly interface with BMS and HVAC equipment without the need for additional protocol translation gateways.

- a. BACnet MS/TP shall support 9600 to 115200 baud rate.
- b. System Controller shall be BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC) with outlined enhanced features.
- 14. System controller shall be provided and installed within an NEMA 1 enclosure with Class 1 and Class 2 separation.
 - a. Enclosure shall support power input power of 120-277VAC.
- B. Wired Networked Graphic Wall Station
 - 1. Product Series: nPOD TOUCH or approved Wattstopper DLM equivalent.
 - 2. Device shall surface mount to single-gang switch box.
 - 3. Device shall have a 3.5" capacitive full color touchscreen.
 - 4. Device shall be powered with Class 2 low voltage supplied locally via directly wired power supply.
 - 5. Device shall have a micro-USB style connector for local computer connectivity.
 - 6. Device shall be equipped with Bluetooth Low Energy (BLE) control.
 - 7. Communication shall be over standard low voltage network cabling with RJ-45 connectors.
 - 8. Device shall enable user supplied screen saver image to be uploaded within one of the following formats: jpg, png, gif, bmp, tif.
 - 9. Device shall enable configuration of all switches, dimmers, control zones, and lighting preset scenes via password protected setup screens.
 - 10. Graphic wall stations shall support the following device options:
 - a. Number of control zones: Up to 16
 - b. Number of scenes: Up to 16
 - c. Profile type scene duration: User configurable from 5 minutes to 12 hours
 - d. Colors: White
- C. Digital Electronic Time Clock
 - 1. Shall control and program a linear bus of lighting devices and supply all time function without connection to a system controller.
 - a. Programming of the linear bus of lighting devices shall not require additional hardware, including computers, specialized dongles, or other connection devices.
 - b. Programming of the linear bus shall be exclusively done through the touch screen interface.
 - 2. Shall be capable of up to 32 schedules. Each schedule shall consist of one set of On and Off times per day for each day of the week and for each of two holiday lists. The schedules shall apply to any individual relay or group of relays.
 - 3. Shall be run from non-volatile memory so that all system programming is retained indefinitely.
 - 4. Shall be optionally mounted inside of a relay panel. Installation inside of the relay panel shall eliminate the necessity of any additional enclosures for complete installation.
 - 5. Device shall have a capacitive 3.5" full color touch screen.

2.04 WIRED NETWORKED DEVICES

- A. Wired Networked Wall Switches, Dimmers & Scene Controllers
 - 1. Wall switches, dimmers and scene controllers shall be the following nLight model numbers, with devices options as specified, or approved Wattstopper DLM equivalent:
 - a. nPODMA (single on/off, pushbuttons).
 - b. nPODMA-D (single on/off, single dimming raise/lower, pushbuttons)
 - c. nPODMA-2P-D (two-channel on/off and dimming raise/lower, pushbuttons).
 - d. nPODMA-4S-D (single on/off, 4-button scene control, dimming raise/lower, pushbutton).
 - 2. Devices shall recess into single-gang switch box and fit a standard GFI opening.
 - 3. Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.
 - 4. All switches shall have the ability to detect when it is not receiving valid communication and blink its LED in a pattern to visually indicate a potential wiring issue.

- 5. Devices with mechanical pushbuttons shall provide tactile and LED user feedback.
- 6. Devices with mechanical pushbuttons shall be made available with custom button labeling.
- B. Wired Networked Occupancy Sensors
 - 1. Occupancy sensors shall be the following nLight model numbers, with device options as specified, or approved Wattstopper DLM equivalent:

Туре	Model # Series	Low Voltage	Lens Type	Detection Tech-	Integral
		Aux. Relay		nology	Photocell
	nCM 9 AR	es	Small Motion	360° PIR	No
	nCM 9 ADC AR	es	Small Motion	360° PIR	es
	nCM PDT 9 AR	es	Small Motion	Dual 360° PIR, Microphonic	No
	nCM PDT 9 ADC AR	es	Small Motion	Dual 360° PIR, Microphonic	es
	nCM PDT 10 AR	es	Large Motion	Dual 360° PIR, Microphonic	No
	nCM PDT 10 ADC AR	es	Large Motion	Dual 360° PIR, Microphonic	es
	nCM 6 AR	es	High Bay	360° PIR	No
	nCM 6 ADC AR	es	High Bay	360° PIR	es
	nWV 16	No	Wide View	120° PIR	No
	nWV 16 PDT	No	Wide View	120° PIR, Mi- crophonic	No

- 2. Occupancy sensors system shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
- 3. Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state; thus, preventing false on conditions. Ultrasonic or Microwave based sensing technologies shall not be accepted.
- 4. For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions), a sensor with an additional "dual" technology shall be used.
- 5. Dual technology sensors shall have one of its two technologies to not require motion to detect occupancy. Acceptable dual technology includes PIR/Microphonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants. Sensors where both technologies detect motion (PIR/Ultrasonic) shall not be acceptable.
- 6. All sensing technologies shall be acoustically passive meaning they do not transmit sounds waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonics technology. Ultrasonic or Microwave based sensing technologies shall not be accepted.
- 7. Ceiling sensors shall be provided with one integrated dry contact switching relay, capable of switching 1 amp at 24 VAC/VDC (resistive only). Dry contact switching relay for use with BAS system integration. Where an integrated relay is not available for a sensor, a discrete relay shall be provided for each sensor and installed in the digital control circuit.
- 8. Sensors shall be available with one or two occupancy "poles", each of which provides a programmable time delay.
- 9. Sensors shall have optional features for photosensor/daylight override, automatic dimming control, and low temperature/high humidity operation.
- 10. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
- 11. All sensors shall have two RJ-45 ports or capable of utilizing a splitter.

- 12. All sensors shall have the ability to detect when it is not receiving valid communication (via CAT-5 connections) and blink its LED in a pattern to visually indicate of a potential wiring issue.
- 13. Every sensor parameter shall be available and configurable remotely from the software and locally via the device push-button.
- 14. Sensors shall be able to function together with other sensors in order to provide expanded coverage areas by simply daisy-chain wiring together the units with CAT-5 cabling.
- C. Wired Networked Wall Switch Sensors
 - 1. Wall switch sensors shall be the following nLight model numbers with device options as specified, or approved Wattstopper DLM equivalent:
 - a. nWS A PDT LV (Dual technology ON/OFF).
 - b. nWS A PDT LV D Dual technology with raise/lower).
 - 2. Wall switch sensors shall recess into single-gang switch box and fit a standard Decora opening.
 - 3. Wall switch sensors must meet NEC grounding requirements by providing a dedicated ground connection and grounding to mounting strap. Line and load wire connections shall be interchangeable. Sensor shall not allow current to pass to the load when sensor is in the unoccupied (OFF) condition.
 - 4. Wall switch sensors shall have optional features for photocell/daylight override, vandal resistant lens, and low temperature/high humidity operation.
 - 5. Wall switch sensors shall be available with optional raise/lower dimming adjustment controls.
 - 6. Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.
 - 7. All wall switch sensors shall have the ability to detect when it is not receiving valid communication and blink its LED in a pattern to visually indicate a potential wiring issue.
 - 8. Devices with mechanical push-buttons shall provide tactile user feedback.
- D. Networked System Daylight (Photocell and/or Dimming) Sensors
 - Photocell sensor shall be the following nLight model numbers with device options as specified, or approved Wattstopper DLM equivalent:
 a. nCM ADC
 - 2. Photocell shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
 - 3. Photocell and dimming sensor's set-point and deadband shall be automatically calibrated through the sensor's microprocessor by initiating an "Automatic Setpoint Programming" procedure. Min and max dim settings as well as set-point may be manually entered.
 - 4. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
 - 5. Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.
- E. Wired Networked Power Packs and Secondary Packs
 - 1. Power (Relay) Packs and Supplies shall be the following nLight model numbers, or approved Wattstopper DLM equivalent:
 - a. nPP16 (Power pack with 16-amp relay).
 - b. nPP16 D (Power pack with 16-amp relay and 0-10VDC dimming output).
 - c. nPP16 ER (UL924 listed secondary pack with 16-amp relay for switching emergency power circuits).
 - d. nPP16 D ER (UL924 listed secondary pack with 16-amp relay and 0-10VDC dimming output for switching emergency circuits).
 - e. nPP20 PL (Power pack with full 20-amp relay switching of general purpose receptacle/circuit).
 - f. nSP5 PCD 2W (Power pack with 5-amp relay and 2-wire dimming)
 - g. nSP5 PCD 3W (Power pack with 5-amp relay and 2-wire dimming)

- h. nSP5 PCD MLV (Power pack with 5-amp relay and magnetic low-voltage dimming)
- i. nSP5 PCD ELV 120 (Power pack with 4-amp relay and electronic low-voltage dimming)
- j. PS 150 (Standard power supply 150mA).
- k. nPS 80 (Auxiliary bus power supply).
- I. nAR 40 (Low voltage auxiliary relay pack
- 2. Power Packs shall incorporate one optional Class 1 relay, optional 0-10 VDC dimming output, and contribute low voltage Class 2 power to the rest of the system.
- 3. Power Packs shall accept 120 or 277 VAC (or optionally 347 VAC) and carry a plenum rating.
- 4. Secondary Packs shall incorporate the relay and 0-10 VDC or line voltage dimming output, but shall not be required to contribute system power.
- 5. Power Supplies shall provide system power only, but are not required to switch line voltage circuit.
- 6. Auxiliary Relay Packs shall switch low voltage circuits only, capable of switching 1 amp at 40 VAC/VDC (resistive only).
- 7. Communication shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors. Secondary packs shall receive low voltage power via standard low voltage network cable.
- 8. Power Pack programming parameters shall be available and configurable remotely from the software and locally via the device push-button.
- 9. Power Pack shall securely mount through a threaded ½ inch chase nipple or be capable of being secured within a luminaire ballast/driver channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.
- 10. When required by local code, Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads
- F. Wired Networked Auxiliary Input/Output (I/O) Devices
 - 1. Auxiliary Input/Output devices shall be the following nLight model number, or approved Wattstopper DLM equivalent:
 - a. nIO D (I/O device with 0-10VDC dimming output).
 - b. nIO 1S (I/O device with contact closure input).
 - 2. Devices shall be plenum rated and be inline wired, screw mountable, or have an extended chase nipple for mounting to a $\frac{1}{2}$ knockout.
 - 3. Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.
 - 4. Specific I/O devices shall have a dimming control output that can control 0-10 VDC dimmable ballasts or LED drivers by sinking up to 20 mA of current (typically 40 or more ballasts.
 - 5. Specific I/O devices shall have a switch input that can interface with either a maintained or momentary switch and run a switch event, run a local/remote control profile, or raise/lower a dimming output.
- G. Wired Networked Relay and Dimming Panel
 - 1. Relay panel shall be following nLight model numbers, or approved Wattstopper DLM equivalent:
 - a. ARP Series
 - 2. Relay and dimming panel(s) shall be provided with a minimum of 4 relays, with an equal number of individual 0-10V dimming outputs.
 - 3. Relays shall have the following required properties:
 - a. Configurable in the field to operate with single-, double-, or triple-pole relay groupings.
 - b. Configurable in the field to operate with normally closed or normally open behavior

- c. Provides visual status of current state and manual override control of each relay.
- d. Listed for the following minimum ratings:
 - 1) 40A at 120-480VAC Ballast
 - 2) 16A at 120-277VAC Electronic
 - 3) 20A at 120-277VAC Tungsten
 - 4) 20A at 48VDC Resistive
 - 5) 2HP at 120VAC
 - 6) 3HP at 240-277VAC
 - 7) 65kA SCCR at 480VAC
- 4. 0-10V dimming outputs shall support a minimum of 100mA sink current per output.
- 5. Relay and dimming outputs shall be individually programmable to support all standard sequence of operations as defined in this specification.
- 6. Panel shall be UL924 listed for control of emergency lighting circuits.
- 7. Panel shall have two RJ-45 ports and be capable of operating as a networked device.
- 8. Panel shall be powered from an integrated 120/277 VAC power supply.
- H. Wired Networked Bluetooth Low Energy Programming Device
 - 1. Bluetooth low energy device shall be the following nLight model number, or approved Wattstopper DLM equivalent:
 - a. nIO BT
 - 2. Device shall be plenum rated and be inline wired, screw mountable.
 - 3. Communication and low voltage power shall be delivered to device via standard low voltage network cabling with RJ-45 connectors.
 - 4. Bluetooth Low Energy connection shall allow connection from smartphone application for programming device settings within the local daisy-chain zone.
 - a. Device shall provide visual indication of remote Bluetooth connection via LED integrated into device enclosure such that it is visible from all angles while the zone is being programmed.
- I. Wired Networked Communication Bridge
 - 1. Communication Bridge device shall be the following nLight model number, or approved Wattstopper DLM equivalent:
 - a. nBRG
 - 2. Device shall surface mount to a standard 4" x 4" square junction box.
 - 3. Device shall have 8 RJ-45 ports for connection to lighting control zones, additional network bridges, and System Controller.
 - 4. Device shall be capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to System Controller.
 - 5. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply, or powered via low voltage network connections from powered lighting control devices (e.g. power packs).
 - 6. Wired Bridge shall be capable of redistributing power from its local supply and connected lighting control zones with excess power to lighting control zones with insufficient local power. This architecture also enables loss of power to a particular area to be less impactful on network lighting control system.
- J. Wireless Networked Communication Adapter
 - 1. A communication adapter shall be provided that interfaces with the System Controller via USB connection and interfaces with wireless networked devices via 900MHz.
 - 2. Device shall be capable of communicating with at least 750 wireless networked devices and luminaires
 - 3. Device shall be supplied with mounting hardware suitable for vertical ceiling mounting or for vertical mounting from a wall.
 - 4. Device shall be unresponsive to wired and wireless communications that do not conform to the specific protocols used by the networked lighting control system.
 - 5. Device shall be IP66 rated and shall be optionally installed in an indoor or outdoor location.

- 6. Device shall allow programming and control of indoor, outdoor, and industrial wireless control devices through a single user interface
- K. Wireless Networked Luminaires
 - 1. Product Series: Networked Luminaires shall be of the following Acuity Brands LED fixtures, which come factory enabled with embedded networking capability.
 - a. Lithonia DS Series

PART 3 EXECUTION

3.01 INSTALLATION REQUIREMENTS

- A. Installation Procedures and Verification
 - 1. The successful bidder shall review all required installation and pre-startup procedures with the manufacturer's representative through pre-construction meetings.
 - 2. The successful bidder shall install and connect the networked lighting control system components according to the manufacturer's installation instructions, wiring diagrams, the project submittals and plans specifications.
 - 3. The successful bidder shall be responsible for testing of all low voltage network cable included in the bid. Bidder is responsible for verification of the following minimum parameters:
 - a. Wire Map (continuity, pin termination, shorts and open connections, etc.)
 - b. Length
 - c. Insertion Loss
- B. Coordination with Owner's IT Network Infrastructure
 - 1. The successful bidder is required to coordinate with owner's representative to secure all required network connections to the owner's IT network infrastructure.
 - a. The bidder shall provide to the owner's representative all network infrastructure requirements of the networked lighting control system.
 - b. The bidder shall provide to the manufacturer's representative all necessary contacts pertaining to the owner's IT infrastructure, to ensure that the system is properly connected and started up.
- C. Documentation and Deliverables
 - 1. The installing contractor shall be responsible for documenting installed location of all networked devices, including networked luminaires. This includes responsibility to provide as-built plan drawing showing device address barcodes corresponding to locations of installed equipment.
 - 2. The installing contractor is also responsible for the following additional documentation to the manufacturer's representative if visualization / graphical floorplan software is provided as part of bid package:
 - a. As-Built floor plan drawings showing device address locations required above. All documentation shall remain legible when reproducing scanning drawing files for electronic submission.
 - b. As-Built electrical lighting drawings (reflected ceiling plan) in PDF and CAD format. Architectural floor plans shall be based on as-built conditions.
 - CAD files shall have layers already turned on/off as desired to be shown in the graphical floorplan background images. The following CAD elements are recommended to be hidden to produce an ideal background graphical image:
 a) Titleblock
 - b) Text- Inclusive of room names and numbers, fixture tags and drawings notes.
 - c) Fixture wiring and homeruns
 - d) Control devices
 - e) Hatching or poche of light fixture or architectural elements.
 - CAD files shall be of AutoCAD 2013 or earlier. Revit file overall floor plan views shall be exported to AutoCAD 2013.

3.02 IDENTIFICATION

- A. Identify system components, wiring, cabling, boxes, cabinets, and terminals. Comply with identification requirements specified in Section 26 0553 "Identification for Electrical Systems."
- B. Identify all ceiling-mounted controls with data bus number and device address.
- C. Label each device cable within 6 inch of connection to bus power supply or termination block.

3.03 FIELD QUALITY CONTROL

- A. Control Start-up and Configuration
 - 1. Contractor shall furnish all labor and test apparatus required to inspect, calibrate and prepare for service all instruments, controls, and accessory equipment furnished hereunder.
 - 2. System start-up and configuration shall be performed by a Manufacturers Certified Field Technician. Service to include.
 - a. Verify that control system has been installed in accordance with the manufacturer's installation instructions.
 - b. Verify that all control and communications wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.
 - c. Verify that all lighting control devices properly communicate on network. Verify communication speed and reliability is acceptable.
 - d. Calibrate light level sensors. Perform calibration in accordance with manufacturers' recommendations.
 - e. Verify function of all installed devices.
 - f. Perform programming and configuration of control system components to achieve specified system performance.
- B. Control System Verification Testing
 - 1. Manufacturers Certified Field Technician shall completely test and verify specified control system performance. Provide verification report demonstrating proper system installation and operation. Verification shall include the following:
 - a. Lighting Control Configuration
 - 1) Provide a list of all programmed time schedules.
 - 2) Provide a list of all sweep times, sweep control on or off, and relays that are swept off.
 - 3) Provide a list of all group load assignments.
 - 4) Provide all photocell control parameters and setpoints.
 - 5) Provide a checkout document indicating the following:
 - a) Lighting relay designation
 - b) Relay number
 - c) Relay description
 - d) Power circuit feeding relay
 - e) Verified relay operation
 - f) Verified time schedule control
 - g) Verified sweep control
 - h) Verified photocell control
 - b. Low Voltage Switches
 - 1) Provide a verification document indicating the following:
 - a) Switch location
 - b) Verified switch operation
 - c) Verified switch override operation
 - c. Occupancy Sensors
 - 1) Provide a verification document indicating the following:
 - a) Room or space designation
 - b) Manufacturer
 - c) Model
 - d) Technology type
 - e) Trigger settings

- f) Time delay settings
- g) Sensitivity settings
- h) Verified sensor operation
- d. Photosensors
 - 1) Provide a verification document indicating the following:
 - a) Room or space designation
 - b) Manufacturer
 - c) Model
 - d) Light level maintained at the work plane
 - e) Provide all parameters and settings for all devices
- e. Demonstration: Demonstrate operation of control system to Engineer, Commissioning Agent, and Owner. Schedule with Owner's Authorized Representative minimum 48 hours prior to Demonstration. Demonstration to include:
 - 1) Menu functions
 - 2) Relay overrides
 - 3) Programming of relays, time schedules
- f. Commissioning Requirements
 - 1) Contractor shall provide a minimum of four hours of on-site assistance to the commissioning provider.
 - 2) Provide necessary software, equipment, or other appurtenances required to execute functional performance testing.
 - 3) Issue Resolution: Where determined that the control system does not function as specified then the Manufacturers Certified Field Technician will meet the Commissioning Provider on-site to investigate and correct observed deficiencies at no additional cost to the Owner.
- C. Training: Provide minimum eight hours of training including operation and maintenance. Coordinate training time with Owner's Authorized Representative minimum 30 days prior to training. Training shall be performed prior to Substantial Completion and will not occur on the same day as equipment start-up.
 - 1. All training sessions shall be videotaped and converted to DVD format for the Owner's use.

3.04 AD USTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION

SECTION 26 2413

SWITCHBOARDS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Service and distribution switchboards rated 600 V and less.
 - 2. Surge protection devices.
 - 3. Disconnecting and overcurrent protective devices.
 - 4. Instrumentation.
 - 5. Control power.
 - 6. Accessory components and features.
 - 7. Identification.
- B. Related Requirements
 - 1. Section 26 0572 Overcurrent Protective Device Short Circuit and Arc Flash Study for arcflash analysis and arc-flash label requirements.

1.03 ACTION SUBMITTALS

- A. Product Data: For each switchboard, overcurrent protective device, surge protection device, ground-fault protector, accessory, and component.
 - 1. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
- B. Shop Drawings: For each switchboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
 - 5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
 - 6. Detail utility company's metering provisions with indication of approval by utility company.
 - 7. Include evidence of NRTL listing for series rating of installed devices.
 - 8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 9. Include schematic and wiring diagrams for power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Seismic Qualification Data: Certificates, for switchboards, overcurrent protective devices, 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. 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.
- C. Field Quality-Control Reports:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.

3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 01 include the following:
 - a. Routine maintenance requirements for switchboards and all installed components.
 - b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - c. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.06 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type but no fewer than two of each size and type.
 - 2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 - 3. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
 - 4. Indicating Lights: Equal to 10 percent of quantity installed for each size and type but no less than one of each size and type.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.
- B. Testing Agency Qualifications: Accredited by NETA.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
- B. Remove loose packing and flammable materials from inside switchboards and to prevent condensation.
- C. Handle and prepare switchboards for installation according to NECA 400.

1.09 FIELD CONDITIONS

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
- B. Environmental Limitations:
 - 1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.
- C. Unusual Service Conditions: NEMA PB 2, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet.

- D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Architect no fewer than 7 days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without Architect's written permission.
 - 4. Comply with NFPA 70E.

1.10 COORDINATION

- A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchorbolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace switchboard enclosures, buswork, overcurrent protective devices, accessories, and factory installed interconnection wiring that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Three years from date of Substantial Completion.
- B. Manufacturer's Warranty: Manufacturer's agrees to repair or replace surge protection devices that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Per requirements in Section 26 0548 – Seismic Controls for Electrical Systems

2.02 SWITCHBOARDS

- A. <u>Manufacturers:</u> Subject to compliance with requirements,:
 - 1. <u>Eaton</u>.
 - 2. GE.
 - 3. Siemens Industry, Inc., Energy Management Division.
 - 4. <u>Square D; Schneider Electric USA</u>.
- B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NEMA PB 2.
- F. Comply with NFPA 70.
- G. Comply with UL 891.
- H. Front-Connected, Front-Accessible Switchboards:
 - 1. Main Devices: Fixed, individually mounted.
 - 2. Branch Devices: Panel mounted.
 - 3. Sections front and rear aligned.

- I. Seismic Requirements: Fabricate and test switchboards according to IEEE 344 to withstand seismic forces defined in Section 26 0548 "Seismic Controls for Electrical Systems."
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. Shake-table testing shall comply with ICC-ES AC156.
 - 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."
- J. Indoor Enclosures: Steel, NEMA 250, Type 1.
- K. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
 - 1. Finish: Factory-applied finish in manufacturer's standard color; undersurfaces treated with corrosion-resistant undercoating.
 - 2. Enclosure: Flat roof; for each section, with provisions for padlocking.
- L. Barriers: Between adjacent switchboard sections.
- M. Service Entrance Rating: Switchboards intended for use as service entrance equipment shall contain from one to six service disconnecting means with overcurrent protection, a neutral bus with disconnecting link, a grounding electrode conductor terminal, and a main bonding jumper.
- N. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- O. Buses and Connections: Three phase, four wire unless otherwise indicated.
 - 1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from the front of the switchboard.
 - 2. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silverplated.
 - 3. Phase- and Neutral-Bus Material: Tin-plated, high-strength, electrical-grade aluminum alloy with tin-plated aluminum circuit-breaker line connections.
 - 4. Copper feeder circuit-breaker line connections.
 - 5. Tin-plated aluminum feeder circuit-breaker line connections.
 - 6. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
 - 7. Ground Bus: Minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.
 - 8. Main-Phase Buses and Equipment-Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
 - 9. Disconnect Links:
 - a. Isolate neutral bus from incoming neutral conductors.
 - b. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.
 - 10. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
 - 11. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
- P. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.
- Q. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.

R. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components including instruments and instrument transformers.

2.03 SURGE PROTECTION DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advanced Protection Technologies Inc. (APT).
 - 2. Eaton.
 - 3. Siemens Industry, Inc., Energy Management Division.
 - 4. Square D; Schneider Electric USA.
- B. SPDs: Comply with UL 1449, Type 1.
- C. Features and Accessories:
 - 1. Integral disconnect switch.
 - 2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
 - 3. Indicator light display for protection status.
 - 4. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status and alarm
 - 5. Surge counter.
- D. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- E. Protection modes and UL 1449 VPR for grounded wye circuits with 208 /120 V, three-phase, four-wire circuits shall not exceed the following:
 - 1. Line to Neutral: 700 V for 208 /120 V.
 - 2. Line to Ground: 1200 V for 208 /120 V.
 - 3. Line to Line: 1000 V for 208 /120 V.
- F. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits shall not exceed the following:
 - 1. Line to Neutral: 700 V.
 - 2. Line to Ground: 700 V.
 - 3. Line to Line: 1000 V.
- G. SCCR: Equal or exceed 200 kA.
- H. Nominal Rating: 20 kA.

2.04 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long and short time adjustments.
 - 4. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
 - c. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Section 26 0913 "Electrical Power Monitoring and Control."

2.05 INSTRUMENTATION

- A. Instrument Transformers: NEMA EI 21.1, and the following:
 - 1. Current Transformers: NEMA EI 21.1; 5 A, 60 Hz, secondary; Burden and accuracy shall be consistent with connected metering and relay devices.
 - 2. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
 - 3. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.
- B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
 - 1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
 - a. Phase Currents, Each Phase: Plus or minus 0.5 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 0.5 percent.
 - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 0.5 percent.
 - d. Megawatts: Plus or minus 1 percent.
 - e. Megavars: Plus or minus 1 percent.
 - f. Power Factor: Plus or minus 1 percent.
 - g. Frequency: Plus or minus 0.1 percent.
 - h. Accumulated Energy, Megawatt Hours: Plus or minus 1 percent; accumulated values unaffected by power outages up to 72 hours.
 - i. Maximum demand (measured of average power demand over a 15 minute period) continuously recorded over a one-year period.
 - j. Total Harmonic Distortion, Amperes.
 - k. Total Harmonic Distortion, Volts.
 - I. Individual Amperage Harmonics through the 63rd.
 - m. Integral Communications Port.
 - n. Megawatt Demand: Plus or minus 1 percent; demand interval programmable from five to 60 minutes.
 - o. Contact devices to operate remote impulse-totalizing demand meter.
 - 2. Mounting: Display and control unit flush or semi-flush mounted in instrument compartment door.

2.06 CONTROL POWER

- A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from controlpower transformer.
- B. Electrically Interlocked Main and Tie Circuit Breakers: Two control-power transformers in separate compartments, with interlocking relays, connected to the primary side of each control-power transformer at the line side of the associated main circuit breaker. 120-V secondaries connected through automatic transfer relays to ensure a fail-safe automatic transfer scheme.
- C. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- D. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.07 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

- C. Portable Circuit-Breaker Lifting Device: Floor-supported, roller-based, elevating carriage arranged for movement of circuit breakers in and out of compartments for present and future circuit breakers.
- D. Overhead Circuit-Breaker Lifting Device: Mounted at top front of switchboard, with hoist and lifting yokes matching each drawout circuit breaker.
- E. Mounting Accessories: For anchors, mounting channels, bolts, washers, and other mounting accessories, comply with requirements in Section 26 0548"Seismic Controls for Electrical Systems" or manufacturer's instructions.

2.08 IDENTIFICATION

A. Per requirements in Section 26 0553 – Identification for Electrical Systems.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Receive, inspect, handle, and store switchboards according to NECA 400 and NEMA PB 2.1.
 - 1. Lift or move panelboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's instructions.
 - 2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.
 - 3. Protect from moisture, dust, dirt, and debris during storage and installation.
 - 4. Install temporary heating during storage per manufacturer's instructions.
- B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
- C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work or that affect the performance of the equipment.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install switchboards and accessories according to NECA 400 and NEMA PB 2.1.
- B. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in Division 03
 - 1. Install conduits entering underneath the switchboard, entering under the vertical section where the conductors will terminate. Install with couplings flush with the concrete base. Extend 2 inches above concrete base after switchboard is anchored in place.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to switchboards.
 - 6. Anchor switchboard to building structure at the top of the switchboard if required or recommended by the manufacturer.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.
- D. Comply with mounting and anchoring requirements specified in Section 26 0548 "Seismic Controls for Electrical Systems."
- E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- F. Install filler plates in unused spaces of panel-mounted sections.

- G. Install overcurrent protective devices, surge protection devices, and instrumentation.1. Set field-adjustable switches and circuit-breaker trip ranges.
- H. Comply with NECA 1.

3.03 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections with the assistance of a factory-authorized service representative .
- E. Tests and Inspections:
 - 1. Acceptance Testing:
 - a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within the switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
 - b. Test continuity of each circuit.
 - 2. Test ground-fault protection of equipment for service equipment per NFPA 70.
 - 3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 4. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - Perform the following infrared scan tests and inspections, and prepare reports:
 - a. panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 6. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Switchboard will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.04 AD USTING

5.

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 0572 Overcurrent Device Short Circuit and Arc Flash Study

3.05 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories.

END OF SECTION

SECTION 26 2416

PANELBOARDS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.
 - 3. Load centers.
 - 4. Electronic-grade panelboards.

1.03 DEFINITIONS

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. MCCB: Molded-case circuit breaker.
- E. SPD: Surge protective device.
- F. VPR: Voltage protection rating.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
 - 1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
 - 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details.
 - 2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
 - 3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
 - 4. Detail bus configuration, current, and voltage ratings.
 - 5. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 6. Include evidence of NRTL listing for series rating of installed devices.
 - 7. Include evidence of NRTL listing for SPD as installed in panelboard.
 - 8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 9. Include wiring diagrams for power, signal, and control wiring.
 - 10. Key interlock scheme drawing and sequence of operations.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NECA 407.

1.08 FIELD CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
 - b. Altitude: Not exceeding 6,600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Architect no fewer than 7 days in advance of proposed interruption of electric service.
 - 2. Do not proceed with interruption of electric service without Architect's written permission.
 - 3. Comply with NFPA 70E.

1.09 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.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.
 1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 26 05 48.16 Seismic Controls for Electrical Systems.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.
- F. Enclosures: 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. Kitchen or Wash-Down Areas: NEMA 250, Type 4 .
 - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - 2. Height: 84 inches maximum.

- 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
- 4. Door in door. 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.
- 5. Finishes:
 - a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel.
 - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.
- G. Incoming Mains:
 - 1. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.
- H. Phase, Neutral, and Ground Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - a. Plating shall run entire length of bus.
 - b. Bus shall be fully rated the entire length.
 - 2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
 - 3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
 - 4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
 - 5. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled by an NRTL acceptable to authority having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors shall be sized for double-sized or parallel conductors as indicated on Drawings. Do not mount neutral bus in gutter.
- I. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Terminations shall allow use of 75 deg C rated conductors without derating.
 - 3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
 - 4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
 - 5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
 - 6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 - 7. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 - 8. Gutter-Tap Lugs: Compression type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
 - 9. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
- J. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- K. 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.

- 1. Panelboards and overcurrent protective devices rated 240 V or less shall have shortcircuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
- 2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.02 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
- B. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type **1** Type **2**.

2.03 LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS

- A. Manufacturers:
 - 1. Eaton
 - 2. Siemens
 - 3. Square D
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- E. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

2.04 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers:
 - 1. Eaton
 - 2. Siemens
 - 3. Square D
- 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 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. MCCB Features and Accessories:
 - a. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.

2.05 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: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
 - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.
PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NECA 407.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Comply with NECA 1.
- C. Install panelboards and accessories according to NECA 407.
- D. Equipment Mounting:
 - 1. Attach panelboard to the vertical finished or structural surface behind the panelboard.
 - 2. Comply with requirements for seismic control devices specified in Section 26 05 48 "Seismic Controls for Electrical Systems."
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- F. Comply with mounting and anchoring requirements specified in Section 26 05 48 Seismic Controls for Electrical Systems.
- G. Mount top of trim 72" above finished floor unless otherwise indicated.
- H. Mount panelboard cabinet plumb and rigid without distortion of box.
- I. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- J. Install overcurrent protective devices and controllers not already factory installed.
- K. 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.
- L. Install filler plates in unused spaces.
- M. Stub four 1-inchempty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inchempty conduits into raised floor space or below slab not on grade.
- N. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.03 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. 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.

3.04 AD USTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 01 30 "Short Circuit and Overcurrent Protective Device Coordination Study."

3.05 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION

SECTION 26 2653

ELECTRIC VEHICLE CHARGING EQUIPMENT LEVEL 2

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes EV charging equipment that provides Level 2 EV charging.

1.03 DEFINITIONS

- A. EV: Electric vehicle.
- B. EV Cable: The off-board cable containing the conductor(s) to connect the EV power controller to the EV that provides both power and communications during energy transfer.
- C. EV Capable: Parking spaces that include nearby termination of raceway (conduit) to a power source with sufficient electrical panel capacity designed for simultaneous charging of electric vehicles in all planned EV parking spaces. Electrical wiring need not be pulled through raceway (conduit) until charging station is installed.
- D. EV Charger or EV Charging Equipment: See "EVSE".
- E. EV Connector: A conductive device that, when electrically coupled to an EV inlet, establishes an electrical connection to the EV for the purpose of power transfer and information exchange. This device is part of the EV coupler.
- F. EV Coupler: A mating EV inlet and connector set.
- G. EV Inlet: The device in the vehicle into which the EV connector is inserted, and a conductive connection is made for the transfer of power and communication. This device is part of the EV coupler.
- H. EV Make Ready: Parking spaces that include nearby termination of raceway (conduit) and electrical wiring pulled to a power source with sufficient electrical panel capacity for simultaneous charging of electric vehicles in all EV parking spaces.
- I. EVSE: Electric Vehicle Supply Equipment. It includes the EV charging equipment and conductors, including the ungrounded, grounded, and equipment grounding conductors and EV cables, attachment plugs, and all other fittings, devices, power outlets, or apparatus installed specifically for transferring energy between the premise wiring and the EV.

1.04 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.05 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 EV charging equipment.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For EV charging equipment.
 - 1. Include plans, elevations, sections, mounting and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Detail fabrication and assembly of mounting assemblies for EV charging equipment.

- 4. Include diagrams for power, signal, and control wiring.
- 5. Include verification of wireless communications service at each location of EV charging equipment.
- C. Product Schedule: For EV charging equipment.

1.06 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Area plans and details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Structural members to which equipment will be attached.
 - 2. Electrical service.
 - 3. Communications service, including wireless communications equipment.
- B. Qualification Data: For Installer.
- C. Seismic Qualification Certificates: For 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. 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.
- D. Field quality-control reports.
- E. Sample Warranty: For manufacturer's warranty.

1.07 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For EV charging equipment to include in operation and maintenance manuals.
- B. Software and Firmware Operational Documentation:
 - 1. Online training and help documentation.
 - 2. Station activation sticker.

1.08 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- C. Comply with UL 2231-1. UL 2231-2, UL 2594, and NEC Article 625.
- D. Comply with SAE J1772.
- E. Comply with FCC Part 15 Class A.

1.09 FIELD CONDITIONS

- A. Wireless Survey: Complete wireless survey to determine if wireless provider signals meet or exceed manufacturer's recommended minimum values.
- B. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not exceeding minus 22 to plus 122 deg F.
 - 2. Altitude: Not exceeding 6600 feet.
- C. Rate Equipment for non-operation under the following conditions:
 - 1. Ambient Temperature: Not exceeding minus 40 to plus 140 deg F.
 - 2. Altitude: Not exceeding 6600 feet.

- D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Owner no fewer than four days in advance of proposed interruption of electric service.
 - 2. Do not proceed with interruption of electric service without Owner's written permission.

1.10 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components of EV charging units that fail(s) in materials or workmanship within specified warranty period.
 - 1. Standard Warranty Period: One year from date of Substantial Completion.
 - 2. Extended Warranty Period: Two years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design Product: Provide ChargePoint CPF25 family of electric vehicle charging stations for dedicated Fleet charging applications.
 - 1. Single station pedestal-mount with cord management (CPF25-L18-CMK6-PD)
 - Two station pedestal-mount with cord management (CPF25-L18-CMK6-PD-DUAL)
 a. Include Power Share Kit for Two station charger.
 - 3. Or approved substitutions.
- B. Source Limitations: Obtain EV charging equipment from single manufacturer.

2.02 EV CHARGING EQUIPMENT 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 use.
- B. Comply with NFPA 70.
- C. ADA compliant.
- D. Metering: /- 2 percent from 2 percent to full scale of output (30 A).
- E. EV Charging Equipment Mounting: Bollard mount.
- F. Enclosures:
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Locations: NEMA 250, Type 3R.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Aluminum and UV-resistant plastic.
 - d. Paint and Anodized.
 - e. Charging components protected by security screws.
 - f. Charging connectors in locking holsters.
 - g. Meter, modem, and CPU, tamper resistant.
- G. EV Cable and Connectors:
 - 1. SAE J1772 connector.
 - 2. One connector with locking holster for single charging station and two connectors with locking holster for dual charging station. Reference Drawings for charging station types.
 - 3. 18-foot cable with cable management system.
- H. Status Indicators:
 - 1. LEDs to indicate power, vehicle charging, charging complete, system status, faults, and service, as well as authorization.
- I. Networking:
 - 1. WAN Communications: Cellular GSM/GPRS and CDMA.
 - 2. LAN Communications: 2.4 GHz Wi-Fi 802.11b/g/n.

- 3. Capable of remote configuration, diagnostics and reporting.
- 4. Capable of remote software updates (future proof).
- J. Charging Network: Compatible with the ChargePoint EV charging network.
 - 1. Multiple units shall independently connect to charging network.
 - 2. Multiple units shall have one unit designated as a master unit that is configured as a gateway unit between the EV charging equipment and the charging network.
 - 3. Individual units shall be capable of indicating station status and availability providing or connecting user to customer support and remote control.

2.03 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
- B. Surge Withstand: 6 kV at 3000 A.
- C. Integral GFCI.
- D. Auto-GFCI fault retry.
- E. Input Power:
 - 1. 40 A, 208/240-V ac, 60 Hz, single phase per charger.
 - 2. Dual circuits do not need to be interlocked.
- F. EV Charging Levels:
 - 1. Single vehicle: AC Level 2 at up to 7.7 kW (CPF25) per vehicle.
 - 2. Dual vehicles, AC Level 2 at up to 7.7 kW (CPF25) per vehicle.
 - 3. Multiple vehicles simultaneously charging at a site using Automatic Power Load Management may be charged up to 7.7 kw (CPF25) per vehicle.

2.04 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for EV charging equipment electrical conduit to verify actual locations of conduit connections before equipment installation.
- C. Examine walls, floors, and pavement for suitable conditions where EV charging equipment will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Comply with NECA 1 and NECA 413.
- B. Concrete Base Mounting:
 - Install EV charging equipment on 6-inch nominal-thickness concrete base. Base should be 24-inch diameter or square (minimum 12-inch from the center located conduit stub-up). Comply with requirements for concrete base specified in Section 03 30 00 "Cast-in-Place Concrete".

- a. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
- b. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
- c. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- d. Install anchor bolts to elevations required for proper attachment to supported equipment.
- e. Secure EV charging equipment to concrete base according to manufacturer's written instructions.
- 2. Install EV charging equipment on 24-inch nominal-diameter and 24-inch concrete base. Comply with requirements for concrete base specified in Section 03 30 00 "Cast-in-Place Concrete."
 - a. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - b. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - c. Secure EV charging equipment to concrete base according to manufacturer's written instructions.
- C. Bollard Mounting:
 - 1. Allow a minimum of 24 inches of clearance around EV charging equipment.
 - 2. EV charging equipment receptacles or holders shall be not less than 24 inches and not more than 4 feet above finished grade.
 - 3. Mount EV charging equipment plumb and rigid without distortion of enclosure.
 - 4. Secure EV charging equipment according to manufacturer's written instructions.
- D. Comply with mounting and anchoring requirements specified in Section 26 05 48 "Seismic Controls for Electrical Systems."
- E. Wiring Method: Install cables in raceways and cable trays. Conceal raceway and cables except in unfinished spaces.
 - 1. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."
- F. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- G. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- H. Circuit Breakers: Comply with Section 26 28 16 "Overcurrent Protective Devices."
- I. Secure covers to enclosure.

3.03 CONNECTIONS

- A. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- B. Comply with grounding requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- C. Comply with requirements for installation of conduit in Section 26 05 33 "Raceways and Boxes for Electrical Systems." Drawings indicate general arrangement of conduit, fittings, and specialties.
- D. Tighten electrical connectors and terminals according to manufacturer's published torquetightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

3.04 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.05 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections with the assistance of a factory-authorized service representative.
- C. Tests and Inspections:
 - 1. For each unit of EV charging equipment, perform the following tests and inspections:
 - a. Unit self-test.
 - b. Operation test with load bank.
 - c. Operation test with EV.
 - d. Network communications test.
- D. EV charging equipment will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.06 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.07 ONGOING MANAGEMENT SERVICES

A. Engage a station manufacturer that offers a service to manage the administration and policies of the electric vehicle charging stations on an ongoing basis.

3.08 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for the duration of an active ChargePoint Network Service Plan.
- B. Upgrade Service: At Substantial Completion, remotely update software to latest version. Install and program software upgrades that become available while an active ChargePoint Network Service Plan is maintained. Upgrading software shall include operating system and new or revised licenses for using software.

3.09 **DEMONSTRATION**

A. Utilize ChargePoint Station Management Services and ChargePoint Assure Services, or Train Owner's maintenance personnel to adjust, operate, and maintain EV charging equipment.

END OF SECTION

SECTION 26 2726

WIRING DEVICES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Standard-grade receptacles, 125 V, 20 A.
 - 2. USB receptacles.
 - 3. GFCI receptacles, 125 V, 20 A.
 - 4. SPD receptacles, 125 V, 20 A.
 - 5. Hospital-grade receptacles, 125 V, 20 A.
 - 6. Hazardous (classified) location receptacles.
 - 7. Twist-locking receptacles.
 - 8. Pendant cord-connector devices.
 - 9. Toggle switches, 120/277 V, 20 A.
 - 10. Wall plates.
 - 11. Floor box assemblies.
 - 12. Poke-through assemblies.
 - 13. Prefabricated multioutlet assemblies.

1.03 DEFINITIONS

- A. AFCI: Arc-fault circuit interrupter.
- B. BAS: Building automation system.
- C. EMI: Electromagnetic interference.
- D. GFCI: Ground-fault circuit interrupter.
- E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- F. RFI: Radio-frequency interference.
- G. SPD: Surge protective device.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.

1.05 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packinglabel warnings and instruction manuals that include labeling conditions.

1.07 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Service-Outlet Assemblies: One for every 10, but no fewer than 1.
 - 2. Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than two.

PART 2 PRODUCTS

2.01 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 use.
- B. Comply with NFPA 70.
- C. RoHS compliant.
- D. Comply with NEMA WD 1.
- E. Devices that are manufactured for use with modular plug-in connectors are not acceptable.
- F. Devices for Owner-Furnished Equipment:
 - 1. Receptacles: Match plug configurations.
 - 2. Cord and Plug Sets: Match equipment requirements.
- G. Device Color:
 - 1. Wiring Devices Connected to Normal Power System: Gray unless otherwise indicated or required by NFPA 70 or device listing.
 - 2. Wiring Devices Connected to Essential Electrical System: Red.
 - 3. SPD Devices: Blue.
- H. Wall Plate Color: For plastic covers, match device color.
- I. Receptacles shall be Industry Class 5362.
- J. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.02 SPECIFICATION GRADE RECEPTACLES, 125 V, 20 A

- 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. Hubbell Incorporated (Commercial and Industrial Group Wiring Device-Kellems).
 - 2. Leviton Manufacturing Co., Inc.
 - 3. Pass & Seymour/Legrand (Pass & Seymour).
- B. Duplex Receptacles, 125 V, 20 A:
 - 1. Description: Two pole, three wire, and self-grounding.
 - 2. Configuration: NEMA WD 6, Configuration 5-20R.
 - 3. Standards: Comply with UL 498 and FS W-C-596.
- C. Tamper-Resistant Duplex Receptacles, 125 V, 20 A:
 - 1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
 - 2. Configuration: NEMA WD 6, Configuration 5-20R.
 - 3. Standards: Comply with UL 498 and FS W-C-596.
 - 4. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.
- D. Weather-Resistant Duplex Receptacle, 125 V, 20 A:
 - 1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
 - 2. Configuration: NEMA WD 6, Configuration 5-20R.
 - 3. Standards: Comply with UL 498.
 - 4. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.
- E. Tamper- and Weather-Resistant Duplex Receptacles, 125 V, 20 A:
 - 1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
 - 2. Configuration: NEMA WD 6, Configuration 5-20R.
 - 3. Standards: Comply with UL 498.

4. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.03 GFCI RECEPTACLES, 125 V, 20 A

- 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. Hubbell Incorporated (Commercial and Industrial Group Wiring Device-Kellems).
 - 2. Leviton Manufacturing Co., Inc.
 - 3. Pass & Seymour/Legrand (Pass & Seymour).
- B. Duplex GFCI Receptacles, 125 V, 20 A:
 - 1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
 - 2. Configuration: NEMA WD 6, Configuration 5-20R.
 - 3. Type: Non-feed through.
 - 4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.
- C. Tamper-Resistant Duplex GFCI Receptacles, 125 V, 20 A:
 - 1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
 - 2. Configuration: NEMA WD 6, Configuration 5-20R.
 - 3. Type: Non-feed through.
 - 4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.
 - 5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.
- D. Tamper- and Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A:
 - 1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
 - 2. Configuration: NEMA WD 6, Configuration 5-15R.
 - 3. Type: Non-feed through.
 - 4. Standards: Comply with UL 498 and UL 943 Class A.
 - 5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.04 WALL PLATES

- A. Single Source: Obtain wall plates from same manufacturer of wiring devices.
- B. 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: 0.035-inch-thick, satin-finished, Type 302 stainless steel.
 - 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.
- C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weatherresistant, die-cast aluminum with lockable cover.

2.05 POKE THROUGH ASSEMBLIES

- 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. FSR, Inc.
 - 2. Hubbell Incorporated (Commercial and Industrial Group Wiring Device-Kellems).
 - 3. Wiremold / Legrand.
- B. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.

- C. Standards: Comply with scrub water exclusion requirements in UL 514.
- D. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
- E. Wiring Raceways and Compartments: For a minimum of five No. 12 AWG conductors and a minimum of eight, four-pair cables that comply with requirements in Division 27.

PART 3 EXECUTION

3.01 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, including 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 comply with NFPA 70, Article 300, without pigtails.
 - 4. Existing Conductors:
 - a. Cut back and pigtail or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.
- D. Device Installation:
 - 1. Replace 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 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 devicemounting screws in yokes, allowing metal-to-metal contact.
 - 10. Verify mounting height and orientation of wiring devices above counter tops and benches with Architectural Details prior to rough-in.
- E. Receptacle Orientation:
 - 1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the left.
- F. Device Plates:
 - 1. Do not use oversized or extra-deep plates.

- 2. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush, level, or do not cover rough wall opening.
- 3. Where outlets are adjacent to each other at same mounting heights, install under common device plate, except where outlets are of different voltages, such as data and duplex receptacle, unless otherwise noted.
- 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, multigang wall plates.
- H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.02 GFCI RECEPTACLES

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A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

3.03 FLOOR BOX AND POKE THROUGH ASSEMBLIES

- A. Set assemblies level and flush with finish flooring material.
- B. Follow manufacturer's installation instructions.

3.04 FLOOR BOX AND POKE THROUGH ASSEMBLIES SCHEDULE

Туре	Floor Style	Nominal Size	Floor Box Style	Wiring Chambers	Model/ Series No.	Accessories	Cover Assemblies	
А	Concrete/ Carpet	14-5/8 in. x 14 in. x 4 in.	Floor Box	6	Evolution RFB6E Series	(2) RFB6DP (3) RFB6GFI (1) RFB6B	(1) 8CTC2 Se- ries	
В	Polished Concrete	13-1/8 in. x 13-1/8 in. x 4 in.	Floor Box	4	Evolution RFB4E Series	(2) RFB6DP (1) RFB6GFI (1) RFB6B	(1) 6CT2 Series (1) RFB4E-CTR	
С	Concrete/ Carpet	13-1/8 in. x 13-1/8 in. x 4 in.	Floor Box	4	Evolution RFB4E Series	(2) RFB6DP (1) RFB6GFI (1) RFB6B	(1) 6CTC2 Se- ries	
D	Concrete/ Carpet	13-1/8 in. x 13-1/8 in. x 4 in.	Floor Box	4	Evolution RFB4E Series	(1) RFB4EKIT	(1) 6CFFTC	
Е	Polished Concrete	13-1/8 in. x 6.5 in. x 3.5 in.	Floor Box	2	Evolution RFB2 Series	(1) RFB2DP (2) RFB2GFI	(1) FPBT Series (1) FP-CTR	

3.05 IDENTIFICATION

- A. Comply with Section 26 0553 Identification for Electrical Systems.
- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.
- C. Essential Electrical System: Mark receptacles supplied from the essential electrical system to allow easy identification using a self-adhesive label.

3.06 FIELD QUALITY CONTROL

- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

- 1. In healthcare facilities, prepare reports that comply with NFPA 99.
- 2. Test Instruments: Use instruments that comply with UL 1436.
- 3. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- D. Tests for Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. 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.
- E. Wiring device will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION

SECTION 26 2913

MOTOR AND CIRCUIT DISCONNECTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provide and install motor disconnects as shown and as required by Code.
- B. Provide and install circuit disconnects as shown and as required by Code.
- C. Disconnects to include mounting stands, brackets, plates, supports, and required hardware and accessories for complete installation.

1.02 REFERENCE STANDARDS

- A. Underwriters' Laboratory (UL)
 - 1. Annual Product Directories
 - 2. UL-98 Enclosed Switches
- B. National Electrical Manufacturer's Association (NEMA)
 - 1. NEMA KS-1 Enclosed Switches

1.03 REQUIREMENTS OF REGULATORY AGENCIES

- A. Conform to National Electrical Code and to applicable inspection authority.
- B. Provide circuit and motor disconnects in the proper enclosure as required by NEC for the location installed unless more stringent requirements otherwise noted on the Drawings or herein.

1.04 SUBMITTALS

- A. Provide submittals for products listed in the Product Table below in accordance with Section 26 05 00 – Common Work Results for Electrical. Submittal requirements indicated by column number designation as follows:
 - 1. Materials List
 - 2. Catalog Data
 - 3. Product Data
 - 4. Performance Data
 - 5. Wiring Diagrams
 - 6. Shop Drawings
 - 7. Installation Instructions
 - 8. Special Requirement listed herein.

PRODUCT TABLE		2	3	4	5	6	7	8
Components								
Single Phase Manual Motor Controller								

- B. Special Requirements:
 - 1. List where required.

PART 2 PRODUCTS

2.01 COMPONENTS

- A. Motor and circuit disconnects shall have an Underwriters' Laboratory label.
- B. Three-Phase Disconnect Switches: Three-pole heavy duty quick make, quick break 600 volt. Number of poles and ampacity as noted or required by Code. Fusible where noted with fuse clips suitable for dual element fuses unless current limiting fuses are noted. Short circuit rating

sufficient to withstand the available fault current or let-through current before the fuse melts without damage or changes in rating.

- C. Compression or set-screw lugs approved for use with copper wire.
- D. ON/OFF Positions: Clearly marked, lockable in "OFF" position.
- E. Cover Interlock:
 - 1. Prevents switch from being opened when "on."
 - 2. Prevents closing switch when cover is open.
 - 3. Defeater to permit authorized personnel to open door and inspect switch when "on," or operate with cover open.
- F. Motor disconnects shall contain minimum 2 NO/NC control circuit disconnecting contacts interlocked with operating handle.
- G. Enclosure for Dry, Indoor Locations: NEMA 1 minimum. Enclosures for outdoor locations: NEMA 3R minimum. Others as required for location installed.

2.02 MANUAL MOTOR CONTROLLER, SINGLE PHASE

- A. Acceptable Manufacturer: Square D.
- B. General: Manual toggle switch with handle guard and lockoff, thermal overload relay, NEMA 1 surface mounted enclosure. Square D, Class 2510 or equal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install motor and circuit disconnects as recommended by manufacturer and as required by Code and UL.
- B. Maintain Code clearances.
- C. Provide a nameplate on each motor and circuit disconnect identifying the equipment item served. Where disconnect is to be installed in existing motor control center replace existing nameplate with new nameplate identifying new equipment item served.

END OF SECTION

SECTION 26 3100

PHOTOVOLTAIC SYSTEM

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Complete Photovoltaic System (PV System)
 - a. Type 1: Independent panel application for over-canopy installation
 - b. Type 2: Unified, weather resistant system panel installation
 - 2. Energy Production Requirements for PV System
 - 3. Installation Requirements for PV System
 - 4. Data Acquisition
 - 5. Supervisory Control
- B. Design-build photovoltaic (PV) electrical system complete with voltage drop calculations, PV array layout, wiring diagrams, structural support frame and attachments to structural steel framing identified on the Structural Drawings meeting design criteria performed by or under the supervision of a Professional Engineer licensed in the State of Oregon. Responsible for providing sealed construction and permit drawings.
- C. A PV electrical system consists of PV modules, PV module racking, photovoltaic inverter(s), conductors, conduit, wire management, remote monitoring and control devices, overcurrent protection, ground-fault protection, arc-fault protection, labels and other balance of system components needed for proper photovoltaic system operation. The PV system may additionally consist of DC string combiner disconnect boxes, rapid shutdown equipment, DC arc-fault protection, inverter output AC combiners and AC recombiners, wiring gutters and electrical panelboards.
- D. The completed PV system integrated into the facility electrical system without impact to the utility service or power quality.
- E. Guarantee electrical work and PV system annual electricity production following date of substantial completion for a period of time equaling two full years of PV System energy production.

1.03 RELATED SECTIONS

- A. Division 01
- B. Division 26
- C. Section 26 0500 General Electrical Provisions
- D. Section 26 0519 Low Voltage Electrical Power Conductors and Cables
- E. Section 26 0526 Grounding and Bonding for Electrical Systems
- F. Section 26 0529 Hangers and Supports for Electrical Systems
- G. Section 26 0533 Raceways and Boxes for Electrical Systems
- H. Section 26 0553 Identification for Electrical Systems
- I. Section 26 1413 Switchboards
- J. Section 26 2416 Panelboards

1.04 WORK INCLUDED

A. Provide grid-interactive PV System complete as described below and indicated on the Drawings.

- 1. PV system consists of all components, wiring, hardware and accessories necessary to integrate a code compliant PV System into the facility with adherence to the Drawings and to ensure grid-interactive system operation.
- 2. PV system arrangement shall be arranged to fit within the allocated area, with general mounting arrangement, tilt and orientation as indicated on Drawings.
- 3. Integrate complete PV system into the facility electrical system without impact to the utility service or power quality.
- 4. Ongoing operations and maintenance services to ensure annual PV System electricity production targets are met during the Performance Period.

1.05 PERFORMANCE

- A. The total PV system size of all array locations shall be as shown on drawings.
 - 1. The first month of operation will be considered to be the first full month of production metered PV electricity.
 - 2. An electricity production shortfall in the first year of operation will be considered a warrantable installation issue under this specification section 1.10.A and shall be addressed by Contractor to ensure design operation is achieved in the second full year of operation. If repairs are necessary, the second full year of operation will commence with the first full month of PV System operation following performance warranty repairs.
- B. Design must include a site-specific shading study. Final layout, string circuiting and inverter design must be optimized to minimize impact from all near-field shading obstructions.
- C. Design and construct a PV system and associated support framing and attachments to mount the structural steel canopy provided on the structural drawings.

1.06 QUALITY ASSURANCE

- A. Design Build contractor to have the following certifications:
 - 1. NABCEP Certified PV Installation Professional.
 - 2. It is permissible for electrical contractors utilizing IBEW photovoltaic trained electricians to team with Solar Integrators who comply with these Specifications.
- B. Design Build Contractor to have minimum of two years of experience within the last five years installing photovoltaic systems of equivalent size and complexity.
- C. PV System Product of a firm regularly engaged in the assembly or manufacture of this equipment. Component parts of the system the product of firms regularly engaged in the manufacture of these parts.
- D. It is the intention of these Specifications to furnish and install a system that can be properly maintained and serviced without the necessity of carrying expensive parts, stocks, or being subjected to the inconvenience of interrupted service due to the lack of available parts.

1.07 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
 - 1. Underwriters Laboratories (UL):
 - a. UL 1703Flat Plate PV Modules and Panels Standard for Safety of Static Inverters and Charge Controllers for use in PV Power systems
 - b. UL 1741 & 1741SA Inverters Converters Controllers and Interconnection System Equipment for Use with Distributed Energy Resources
 - c. UL 2703Standard for Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels
 - 2. ASTM Standards:
 - a. ASTM E927 Solar Simulation for Terrestrial PV Testing
 - b. ASTM E1038 Test Method for Determining Resistance of PV Modules to Hail by Impact with Propelled Ice Balls
 - c. ASTM E1171 Test Method for PV Modules in Cyclic Temperature and Humidity Environments
 - d. ASTM E1328 Terminology Relating to PV Solar Energy Conversion

- e. ASTM E1462 Test Methods for Solar Insulation Integrity and Ground Path Continuity of PV Modules
- f. ASTM E1596 Test Methods for Solar Radiation Weathering of PV Modules
- g. ASTM E1799 Test Methods for Visual Inspection of PV Modules
- h. ASTM E1802 Test Methods for Wet Insulation Integrity Testing of PV Modules
- 3. IEEE Standards:
 - a. IEEE 1547a-2014IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems – Amendment 1
- 4. National Electrical Code (NEC):
 - a. NEC Article 690 Solar PV Systems
 - b. NEC Article 705Interconnected Electric Power Production Sources
- 5. FM Approvals
 - a. FM ANSI 4478Approval Standard for Rigid Photovoltaic Modules
 - International Electrotechnical Commission (IEC)
 - a. IEC 61215Terrestrial Photovoltaic (PV) Modules Design Qualification and Type Approval

1.08 CONTRACTOR DESIGN

6.

- A. The equipment shown on the Drawings indicate the general nature of the photovoltaic system, but does not show specific components required. It is the responsibility of the Contractor to provide a complete photovoltaic system as needed to meet applicable codes and requirements under this Section.
- B. Raceway, routing, and wiring for PV system devices are not shown on the Drawings except for a few specific design requirements.
- C. Attachment points of the photovoltaic system to the building structure are the responsibility of the Contractor. Provide coordination with the project Architect and Structural Engineer. Provide calculations and details approved by a registered State of Oregon Structural Engineer.
- D. Design all PV modules, associated racking, structural supports and attachments for wind speeds and surface roughness exposures in accordance with the Structural Engineers Association of California SEAOC PV2-1012, "Wind Design for Low Profile Solar Photovoltaic Arrays on Flat Roofs" using the following structural design criteria:
 - 1. Importance Factor 1.50
 - 2. Exposure
 - 3. KZT as determined using ASCE 7, except for locations with relatively flat terrain (10° ground slope), where KZT can be assumed to be 1.0.
 - 4. Minimum Safety Factor (SF) of 2.0 for wind loads on module and racking anchors.
 - 5. Minimum Safety Factor of 1.6 for other wind loads.
- E. All inverters and other PV related balance of system equipment shall be mounted to the building structure or PV canopy array structural members as required to provide proper anchorage against expected loads in compliance with the seismic rating of the structure. Design shall utilize anchors that can be connected to the equipment and to the array canopy structure.
- F. The maximum tilt for any PV module or PV sub-array within the overall PV array shall be 20 degrees.
- G. PV System electrical design shall incorporate the following either by UL listed integration into major system components or additional UL listed balance of system components that provide equivalent functionality:
 - 1. Ground fault detection systems for all DC system conductors and connected devices with an alarm function for ungrounded PV system topology with non-isolated PV inverters.
 - 2. Surge protection for the PV inverters and other equipment on both the AC and DC sides of the system.
 - 3. Reverse overcurrent protective devices (fuses or circuit breakers) for parallel connected series strings of PV modules to prevent reverse current flow from undamaged PV system

circuits causing additional damage (arcing, overheating, fire, etc.) to damaged modules or shorted wiring and/or other system components.

- 4. Rapid shutdown functionality with point of operation for rapid shutdown initiation as required by Code and the AHJ. Design shall be approved with the AHJ prior to installation.
- H. PV array conductors that are installed outside of electrical raceways shall utilize PV wire that is moisture and sunlight resistant with a temperature rating of 194°F to avoid premature conductor insulation failure. Electrical conductors installed within sunlight resistance raceways shall be rated for wet locations and for the expected temperature exposure at the site during PV system operation.
- I. The design shall ensure adequate provisions are made for expansion and contraction of all system components due to extreme temperature fluctuations during the year. This includes wiring and raceways as well as all attachment interfaces between the PV modules and the building structure.
- J. The PV system design shall be fully compliant with the distribution utility's interconnection requirements.
- K. The design shall minimize the negative impacts of shading from the structure or other obstructions by electrically isolating the PV source and output circuits associated with PV modules that are subject to localized shading from other modules within the array. A shaded PV module shall be considered to be any PV module that is wholly or partially shaded from 9:00 AM to 3:00 PM for any day of the year.
- L. PV contractor

1.09 SUBMITTALS

- A. PV component product data including:
 - 1. PV module product information cut sheet
 - 2. PV inverter product information cut sheet
 - 3. PV inverter communication card product information cut sheet
 - 4. Rapid shutdown compliance product information cut sheet
 - 5. Product information cut sheets for major balance of systems components.
 - 6. Product information cut sheets for communications devices associated with supervisory control, direct metering or performance monitoring of the PV system
- B. Shop Drawings, to include a complete PV system design for installation by the Contractor:
 - 1. Photovoltaic single line diagram
 - 2. Raceway and conductor sizing
 - 3. Grounding and bonding details
 - 4. Plan view and layout drawings
 - 5. DC source and output circuit voltage drop calculations
 - 6. PV system efficiency calculations including tilt and orientation factor, percent shading, and total solar resource fraction.
 - 7. PV System annual energy production estimates.
 - a. Calculations shall utilize historical TM 3 weather data from nearest weather station.
 - b. Calculations shall assume a once annual cleaning of all PV System modules and Contractor will make recommendations in the submittal as to the timing for cleaning to achieve maximum annual energy production.
 - c. Provide all calculation assumptions (efficiencies, losses, etc.) used to derive the annual energy production estimate.
 - 8. Structural calculations, details, and shop drawings for the PV system support structure and attachment to the canopy system, sealed by a structural professional engineer licensed within the state of Oregon.
 - 9. Design a PV system and associated support framing to mount to the structural steel canopy frame provided on the structural drawings.

1.10 DOCUMENTATION

- A. Provide complete documentation necessary for permitting, construction, federal tax credits, state and utility incentive programs, and utility interconnection application.
- B. Provide estimates of annual PV System electricity production during the Performance Period.
- C. Provide PV System Commissioning Report and As-Built documentation as detailed in this specification Section 3.5.

1.11 COMPONENT AND INSTALLATION WARRANTY

- A. Installation:
 - 1. Provide the Owner with a full two-year warranty on the entire PV system and of the installed components, equipment, and labor.
 - 2. Provide warranty for service at the site including the repair and/or replacement of components found to be defective for two years after project acceptance.

B. PV Modules

- 1. Minimum 25-year warranty against defects in materials and workmanship.
- 2. Performance degradation warranty such that the actual power output of the PV module will be no less than 90 percent of the module's nameplate rated power output after 10 years of in-field service and no less than 80 percent of the module's nameplate rated power output after 25 years of in-field service.
- 3. Repair or replace the defective components in cases of failure or underperformance due to materials or workmanship.
- C. Photovoltaic Inverter
 - 1. Minimum 10-year warranty against defects in materials and workmanship.
 - 2. Repair or replace the defective components in cases of failure due to materials or workmanship.
- D. Electronics and Balance of System Components:
 - 1. Minimum 10-year warranty against defects in materials and workmanship.
 - 2. Repair or replace the defective components in cases of failure due to materials or workmanship.
- E. PV Module Racking
 - 1. Minimum 10-year warranty against defects in materials and workmanship.
 - 2. Repair or replace the defective components in cases of failure due to materials or workmanship.

PART 2 PRODUCTS

2.01 EQUIPMENT MANUFACTURERS

A. The contractor shall select and design the photovoltaic system using products that are adherent to the requirements set forth in Part 2 of this specification.

2.02 PHOTOVOLTAIC MODULES

- A. Basis of design product: TrinaSolar.
- B. Acceptable alternative manufacturers: SunPower, LG Solar, Canadian Solar
- C. UL 1703 compliant.
- D. Photovoltaic conversion efficiency of 18 percent or greater.
- E. Modules shall have a hail impact rating that meets or exceeds ANSI 4478, American National Standard for Rigid Photovoltaic Modules. At a minimum, the hail rating should be per IEC 61215 using a 45 mm (1-3/4 in.) or greater ice ball.
- F. Power tolerance of no less than -3 percent of listed nameplate rating.
- G. Module and integral accessories rated for 1000V DC PV source circuit configurations.
- H. No voltage induced power degradation.
- I. Rated for operation from -40 degrees F to 185 degrees F.

- J. MC4 compatible quick connects.
- K. High transmission module front glass with anti-reflective coating or similar inherent properties.
- L. Front and back of module and frame are wind load rated for 50 PSF.
- M. Front of module and frame are snow load rated for 110 PSF.
- N. All other module environmental ratings shall exceed historic conditions for the installation location.
- O. Equipment ratings and structural mounting must comply with the seismic requirements of a risk Category IV facility in accordance with the 2016 Edition of the Building Standards Code.

2.03 PHOTOVOLTAIC INVERTERS

- A. Basis of design product: SolarEdge.
- B. Provide a DC to AC power inverter that is compatible with the Contract Drawings and adherent to the local AHJ and electrical utility interconnection requirements.
- C. The inverter shall be able to operate unattended in an automatic pre-programmed failsafe mode.
- D. PV inverter environmental product ratings shall exceed historic weather conditions for the installation location.
- E. Display screen or ability to connect display screen to provide read-out of operational system states, input, and output voltages, AC currents, wattage, etc and permit local programming and control of the inverter.
- F. Inverter shall be equipped with communication gateway or similar hardware to permit MODBUS TCP/IP or MODBUS RTU communication of operational status to a third-party data acquisition entity. Other communications protocols may be acceptable with prior approval.

2.04 RAPID SHUTDOWN SYSTEM

- A. PV system rapid shutdown shall be integral to the PV inverter(s) and module level DC-DC optimizers.
- B. Rapid shutdown initiation shall be accomplished via de-energization or disconnection of the inverter output circuit(s) from the utility AC waveform.
- C. Rapid shutdown system shall ensure that controlled conductors outside the array boundary are limited to not more than 30VDC and 240VA within thirty (30) seconds of rapid shutdown initiation.

2.05 REMOTE MONITORING

A. Provide supervisory control and data acquisition capability to the photovoltaic inverter(s) via a MODBUS TCP/IP or MODBUS RS485 communication link to the energy management system.

2.06 ELECTRICAL BALANCE OF SYSTEMS

A. Provide all balance of systems components to ensure an operational system that is compatible with the Contract Drawings, major system components as required by this and other specifications and adherent to the local AHJ and electrical utility interconnection requirements.

2.07 PHOTOVOLTAIC MODULE RACKING

- A. The photovoltaic racking product shall be compatible with the selected PV module and provide the means of structural support for the modules within the PV array. The racking system shall attach to the canopy structure according to the Contract Drawings and be rated for all loading conditions as required by code and project specific seismic resilient structural design.
 - 1. Contractor will verify PV module structural design pressures and array racking design with the project structural engineer prior to installation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrate areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Do not begin installation until mounting surfaces have been properly prepared.
- C. If preparation of mounting surfaces is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- D. Examine modules and array frame before installation. Reject modules and arrays that are wet, moisture damaged, or mold damaged.
- E. Examine roofs, supports, and supporting structures for suitable conditions where PV system will be installed.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 EQUIPMENT INSTALLATION

- A. Protect all equipment during shipping, handling, and storage to comply with manufacturer's requirements and to prevent damage including physical, condensation, temperature changes, sun, chemical, and other. Store equipment in a clean, dry environment. Contractor will be responsible for replacing all equipment damaged prior to and during installation and prior to system Acceptance.
- B. Furnish and install materials required for a complete and operational system. Provide required structural components and hardware to mount the PV arrays to the building structure. Anchor and secure elevated equipment with a safety factor of 4. Coordinate PV array anchor points with building structure tie points.
- C. Install rapid shutdown combiner boxes or optimizers within the solar array boundary to comply with NEC 690.12(B)(2). Install all PV system labels as required by NEC as well as the local AHJ and fire department.
- D. Contractor is responsible for compliance with all OSHA requirements. Contractor shall avoid live electrical work of any kind when possible. If live electrical work is unavoidable, the Contractor shall take all necessary precautions to prevent hot work electrical fires and arc flash exposure.

3.03 ELECTRICAL WIRING

- A. Except for UV exposure rated PV Wire installed in free-air behind PV modules, all PV System wiring shall be installed in listed and appropriately sized metallic conduits. PV System conductors installed shall consider route, length, and sized to keep voltage drop below 2 percent. Routing of raceways between PV arrays shall be kept concealed and hidden behind or underneath the PV array or sub-arrays whenever possible. Electrical connections between the various items of the System shall be rung out and tested for continuity prior to energizing.
- B. For PV Wire installed in free-air behind PV modules, both the DC positive and DC negative conductors, including all string home-run conductors, shall be routed together and shall have at least one full twist of the combined positive and negative conductor set per linear foot of conductor pathway. The twisting together of the DC positive and DC negative conductor prevents the formation of a loop antenna which can induce unwanted radio frequency interference on the communications antenna equipment located in close proximity to the PV array. At no point shall a single DC conductor be routed separately.
- C. Provide labels for PV source circuit string wiring leads within DC combiner and/or DC recombiner boxes, enclosures and panel assemblies to clearly indicate both DC negative and DC positive as well a unique series string identifier.

3.04 COORDINATION

A. Coordinate PV system installation with all other trades to ensure an integrated, workmanlike installation.

B. If a battery system has been included on the project at the time of installation, coordinate PV System installation with Battery Energy Storage System (BESS) install to ensure acceptable PV system disconnecting means are provided to electrically isolate the PV system from the BESS and vice versa.

3.05 SUPERVISION

- A. Supervise, check, and test installation and startup by a qualified representative of the PV System inverter manufacturer.
- B. Caution needs to be exercised in the installation of the PV modules, in that they can generate lethal voltages when exposed to sunlight. The PV modules may produce potentially lethal open circuit voltage when they are removed from their enclosed shipping containers. The PV System integrator shall be responsible for establishing and enforcing an energized equipment safety protocol for those working with and around the installation of the PV modules.

3.06 FIELD TESTING, COMMISSIONING AS BUILT DOCUMENTATION

- A. After the installation and initial start-up of the PV System is complete, a test shall be performed and logged in the presence of the Architect. The PV System integrator shall furnish an engineer to monitor the system during the tests, to check details of the installation and to instruct the operators. This engineer will be required for a period of not less than 2 days for instruction and tests. Cost for this engineering service shall be included in the Contractor's bid. Furnish instruments necessary to conduct the tests and connect devices required to obtain data required.
- B. Field Test Requirements:
 - 1. Record data and results as required to prepare the Commissioning Report submittal as detailed in Section 3.5.C.
 - 2. Additional test data shall include:
 - a. Test the AC line voltage at PV system AC disconnect(s) to confirm that it is within 2 percent of system rated line to line and line to ground voltage. Record voltage data.
 - b. Test the continuity of DC fuses (if applicable) to be installed in each DC string combiner box.
 - c. Test PV array open circuit DC voltage at each inverter DC disconnect switch to ensure voltage is within proper limits according to the inverter manufacturer's installation manual.
- C. PV System Commissioning Report
 - 1. Contractor to provide a commissioning report that conforms to the SunSpec Alliance Best Practices Guide for Commissioning for PV Performance (D42039-1). The report shall include the following sections with associated data and results:
 - a. PV system information and data collected at time of commissioning
 - 1) System name, address location
 - 2) System size, type (fixed, tracking), module, inverter, pitch and azimuth
 - 3) As-built system derate factors
 - a) Module mismatch loss
 - b) DC wiring loss
 - c) PV module nameplate mismatch loss
 - d) Power optimizer loss (if applicable)
 - e) AC wiring loss
 - f) Step-up transformer loss (if applicable)
 - 4) Name of person(s) performing the tests and reporting the results
 - 5) Test equipment used (monitoring/model, irradiance sensor, temperature sensor, etc.)
 - 6) Period of time for measurements
 - 7) Number of measurements taken and used
 - 8) Irradiance measured (and conversion of POA to GHI if appropriate)
 - 9) Temperature measured (and conversion of ambient to module/cell if appropriate)

- 10) Wind Speed Measured
- 11) AC power measured
- b. Calculation of the Power Performance Index (PPI) and associated findings
 - 1) Calculation method and associated system derate factors used to calculate PPI
 - 2) PPI calculated (measured kWac to expected kWac)
 - 3) Uncertainty of the test results and acceptable tolerances
 - 4) Notes on significant findings or observances
 - 5) Summary and narrative of the outcome, with an action plan, if required
- c. PV source circuit performance data in the form of the following information for each electrically isolatable PV string within the overall PV array
 - 1) Performance Factor
 - 2) Fill Factor
 - 3) Short Circuit Current (Isc)
 - 4) Open Circuit Voltage (Voc)
 - 5) Maximum Power Current (Imp)
 - 6) Maximum Power Voltage (Vmp)
 - 7) String Maximum Power (Pmax)
 - 8) I-V curve graph test results for each string
- D. Operations and Maintenance Data:
 - 1. Provide complete instructions covering the operation of the PV System and associated equipment for the facility, together with a manual covering system operation and maintenance.
 - 2. Operation instructions include future operational adjustments, utility operational requirements, and incentive program renewals required to obtain optimum energy production and/or financial benefit from the PV system.
 - 3. Dated print-out of PV inverter settings showing field configurable settings.
 - 4. Digital copy of PV inverter settings file. If the settings file varies by inverter, indicate the PV inverter serial number in the digital settings file filename.
 - 5. Maintenance instructions include complete troubleshooting and diagnostic information, disassembly instructions, assembly instructions, and a preventive maintenance schedule.
 - 6. The preventive maintenance schedule in outline form. Include recommended cleaning practices and specified necessary service checks. Furnish spare parts books for the array and associated equipment.
 - 7. Include data in Operating and Maintenance Manuals specified in Section 26 0500, Common Work Results for Electrical.
- E. As-Built Documentation
 - 1. Plan view of PV array(s) with serial number mapping for each PV module and PV inverter associated with the PV system.
 - 2. Updated PV one-line diagrams with as-built conduit and conductor information with installed lengths of PV system feeders (PV source circuits, PV output circuits and PV inverter input circuits).
 - 3. Updated one-line drawing of Rapid Shutdown system showing all system components, component locations and system cabling with sizes and lengths.

3.07 ACCEPTANCE

A. Final acceptance made when the PV System integrator has successfully completed the on-site tests, after any defects in material or operation has been corrected and all Submittals and Documentation have been submitted to, reviewed by and accepted the project Architect.

END OF SECTION

SECTION 26 3213.14

DIESEL ENGINE GENERATORS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes packaged engine generators used to supply non-emergency power, with the following features:
 - 1. Diesel engine.
 - 2. Diesel fuel-oil system.
 - 3. Control and monitoring.
 - 4. Generator overcurrent and fault protection.
 - 5. Generator, exciter, and voltage regulator.
 - 6. Outdoor engine generator enclosure.
 - 7. Remote radiator motors.
 - 8. Vibration isolation devices.
 - 9. Finishes.
- B. Related Requirements:
 - 1. Section 26 36 00 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine generators.

1.03 DEFINITIONS

A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 2. Include thermal damage curve for generator.
 - 3. Include time-current characteristic curves for generator protective device.
 - 4. Include fuel consumption in gallons per hour at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
 - 5. Include generator efficiency at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
 - 6. Include airflow requirements for cooling and combustion air in cubic feet per minuteat 0.8 power factor, with air-supply temperature of 95, 80, 70, and 50 deg F. Provide Drawings indicating requirements and limitations for location of air intake and exhausts.
 - 7. Include generator characteristics, including, but not limited to, kilowatt rating, efficiency, reactances, and short-circuit current capability.
- B. Shop Drawings:
 - 1. Include plans and elevations for engine generator and other components specified. Indicate access requirements affected by height of subbase fuel tank.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Identify fluid drain ports and clearance requirements for proper fluid drain.
 - 4. Design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 - 5. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include base weights.

6. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for engine generators and functional relationship between all electrical components.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Seismic Qualification Data: Certificates, for engine generator, 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. Dimensioned Outline Drawings of Equipment Unit: With engine and generator mounted on rails, identify center of gravity and total weight, including full fuel tank, supplied enclosure, external silencer, subbase-mounted fuel tank, and each piece of equipment not integral to the engine generator, 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.
- C. Source Quality-Control Reports: Including, but not limited to, the following:
 - 1. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
 - 2. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
 - 3. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
 - 4. Report of sound generation.
 - 5. Report of exhaust emissions showing compliance with applicable regulations.
- D. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 01 include the following:
 - a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
 - b. Operating instructions laminated and mounted adjacent to generator location.
 - c. Training plan.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.08 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 1 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Cummings.
- B. Substitutions: See Section 01 0600 Product Requirements.
- C. Source Limitations: Obtain packaged engine generators and auxiliary components from single source from single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Engine generator housing, subbase fuel tank, engine generator, batteries, battery racks, silencers, sound attenuating equipment, accessories, and components shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Shake-table testing shall comply with ICC-ES AC156. Testing shall be performed with all fluids at worst-case normal levels.
 - 3. Component Importance Factor: 1.0.
- B. B11 Compliance: Comply with B11.19.
- C. NFPA Compliance:
 - 1. Comply with NFPA 37.
 - 2. Comply with NFPA 70.
- D. UL Compliance: Comply with UL 2200.
- E. Engine Exhaust Emissions: Comply with EPA Tier 4 requirements and applicable state and local government requirements.
- F. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by engine generator including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.
- G. Environmental Conditions: Engine generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: 5 to 104 deg F.
 - 2. Altitude: Sea level to 1000 feet Insert altitude .

2.03 ENGINE GENERATOR ASSEMBLY DESCRIPTION

- A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- C. Power Rating: Industrial.
- D. Service Load: See Drawings.
- E. Power Factor: 0.8, lagging.
- F. Frequency: 60 Hz.
- G. Governor: Adjustable isochronous, with speed sensing.
- H. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.
 - 1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and engine generator center of gravity.
- I. Capacities and Characteristics:
 - 1. Power Output Ratings: Nominal ratings as indicated excluding power required for the continued and repeated operation of the unit and auxiliaries.
 - 2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- J. Engine Generator Performance:
 - 1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.

- 2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent stepload increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
- 3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
- 4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
- 5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
- 6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
- 7. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
- 8. Start Time: 10 seconds.

2.04 DIESEL ENGINE

- A. Fuel: ASTM D975, diesel fuel oil, Grade 2-D S15.
- B. Rated Engine Speed: 1800 rpm.
- C. Lubrication System: Engine or skid-mounted.
 - 1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
 - 2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
 - 3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- D. Jacket Coolant Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with UL 499.
- E. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine generator set mounting frame and integral engine-driven coolant pump.
 - 1. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 - 2. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
 - 3. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, UV-, and abrasion-resistant fabric.
 - a. Rating: 50-psig maximum working pressure with coolant at 180 deg F, and noncollapsible under vacuum.
 - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
 - 4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
- F. Air-Intake Filter: Standard-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- G. Starting System: 24-V electric, with negative ground.
 - 1. Components: Sized so they are not damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Performance Requirements" Article.

- 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
- 3. Cranking Cycle: 60 seconds.
- 4. Battery: Lead acid, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least twice without recharging.
- 5. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.

2.05 DIESEL FUEL OIL SYSTEM

- A. Comply with NFPA 30.
- B. Piping: Fuel-oil piping shall be Schedule 40 black steel, complying with requirements in Section 23 11 13 "Facility Fuel-Oil Piping." Cast iron, aluminum, copper, and galvanized steel shall not be used in the fuel-oil system.
- C. Main Fuel Pump: Mounted on engine to provide primary fuel flow under starting and load conditions.
- D. Fuel Filtering: Remove water and contaminants larger than 1 micron.
- E. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
 - 1. Fuel Tank Capacity: As recommended by engine manufacturer for an uninterrupted period of 24 hours' operation at 100 percent of rated power output of engine generator system without being refilled.
 - 2. Duplex Fuel-Oil Transfer Pump
 - 3. Piping Connections: Factory-installed fuel supply and return lines from tank to engine; local fuel fill, vent line, overflow line; and tank drain line with shutoff valve.
- F. Subbase-Mounted, Double-Wall, Fuel-Oil Tank: Factory installed and piped, complying with UL 142 fuel-oil tank. Features include the following:
 - 1. Tank level indicator.
 - 2. Fuel-Tank Capacity: Minimum 133 percent of total fuel required for planned operation plus fuel for periodic maintenance operations between fuel refills.
 - 3. Leak detection in interstitial space.
 - 4. Vandal-resistant fill cap.

2.06 CONTROL AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of engine generator. When mode-selector switch is switched to the on position, engine generator starts. The off position of same switch initiates engine generator shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.
- B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts engine generator. The off position of same switch initiates engine generator shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.
- C. Provide minimum run time control set for 15 minutes with override only by operation of a remote emergency-stop switch.
- D. Comply with UL 508A.
- E. Control and Monitoring Panel:
 - 1. Digital engine generator controller with integrated LCD display, controls, and microprocessor, capable of local and remote control, monitoring, and programming, with battery backup.
 - a. Engine lubricating-oil pressure gage.

- b. DC voltmeter (alternator battery charging).
- c. Running-time meter.d. AC voltmeter, for each phase.
- e. AC ammeter, for each phase.
- AC frequency meter. f.
- Generator-voltage adjusting rheostat. g.
- Controls and Protective Devices: Controls, shutdown devices, and common alarm 2. indication, including the following:
 - Cranking control equipment. a.
 - Run-Off-Auto switch. b.
 - Control switch not in automatic position alarm. C.
 - d. Overcrank alarm.
 - Overcrank shutdown device. e.
 - Low-water temperature alarm. f.
 - High engine temperature pre-alarm. g.
 - h. High engine temperature.
 - i. High engine temperature shutdown device.
 - j. Overspeed alarm.
 - k. Overspeed shutdown device.
 - I. Low fuel main tank.
 - Low-fuel-level alarm shall be initiated when the level falls below that required for 1) operation for duration required in "Fuel Tank Capacity" Subparagraph in "Diesel Fuel-Oil System" Article.
 - m. Coolant low-level alarm.
 - Coolant low-level shutdown device. n.
 - Coolant high-temperature prealarm. Ο.
 - Coolant high-temperature alarm. p.
 - Coolant low-temperature alarm. q.
 - Coolant high-temperature shutdown device. r.
 - s. Battery high-voltage alarm.
 - Low cranking voltage alarm. t.
 - Battery-charger malfunction alarm. u.
 - Battery low-voltage alarm. ۷.
 - w. Lamp test.
 - Contacts for local and remote common alarm. х.
 - Low-starting air pressure alarm. у.
 - z. Low-starting hydraulic pressure alarm.
 - aa. Remote manual stop shutdown device.
 - bb. Air shutdown damper alarm when used.
 - cc. Air shutdown damper shutdown device when used.
 - dd. Generator overcurrent-protective-device not-closed alarm.
 - ee. Hours of operation.
 - ff. Engine generator metering, including voltage, current, hertz, kilowatt, kilovolt ampere, and power factor.
- F. Remote Alarm Annunciator: An LED indicator light labeled with proper alarm conditions shall identify each alarm event, and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.
 - Overcrank alarm. 1.
 - Low water-temperature alarm. 2
 - High engine temperature pre-alarm. 3.
 - 4. High engine temperature alarm.
 - 5. Low lube oil pressure alarm.
 - 6. Overspeed alarm.

- 7. Low fuel main tank alarm.
- 8. Low coolant level alarm.
- 9. Low cranking voltage alarm.
- 10. Contacts for local and remote common alarm.
- 11. Audible-alarm silencing switch.
- 12. Air shutdown damper when used.
- 13. Run-Off-Auto switch.
- 14. Control switch not in automatic position alarm.
- 15. Fuel tank derangement alarm.
- 16. Fuel tank high-level shutdown of fuel supply alarm.
- 17. Lamp test.
- G. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator unless otherwise indicated.
- H. Remote Emergency-Stop Switch: Flush; wall mounted unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.07 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Overcurrent protective devices shall be coordinated to optimize selective tripping when a short circuit occurs.
- B. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with UL 489.
 - 1. Tripping Characteristic: Designed specifically for generator protection.
 - 2. Trip Rating: Matched to generator output rating.
 - 3. Mounting: Adjacent to, or integrated with, control and monitoring panel.

2.08 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H.
- D. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- E. Enclosure: Dripproof.
- F. Instrument Transformers: Mounted within generator enclosure.
- G. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
 - 1. Adjusting Rheostat on Control and Monitoring Panel: Provide plus or minus 5 percent adjustment of output-voltage operating band.
 - 2. Maintain voltage within 15 percent on one step, full load.
 - 3. Provide anti-hunt provision to stabilize voltage.
 - 4. Maintain frequency within 5 percent and stabilize at rated frequency within seconds.
- H. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.
- I. Subtransient Reactance: 12 percent, maximum.

2.09 OUTDOOR ENGINE GENERATOR ENCLOSURE

- A. Description: Vandal-resistant, sound-attenuating, weatherproof steel housing; wind resistant up to 100 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.
 - 1. Sound Attenuation Level: Level 1

- B. Description: Prefabricated or pre-engineered, galvanized-steel-clad, integral structural-steelframed, walk-in enclosure; erected on concrete foundation.
- C. Structural Design and Anchorage: Comply with ASCE/SEI 7 for wind loads up to 100 mph.
- D. Seismic Design: Comply with seismic requirements in Section 26 05 48.16 "Seismic Controls for Electrical Systems."
- E. Hinged Doors: With padlocking provisions.
- F. Space Heater: Thermostatically controlled and sized to prevent condensation.
- G. Lighting: Provide weather-resistant LED lighting with 30 fc average maintained.
- H. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine generator components.
- I. Muffler Location: Within enclosure.
- J. Engine-Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for two hours with ambient temperature at top of range specified in system service conditions.
 - 1. Louvers: Fixed-engine, cooling-air inlet and discharge. Stormproof and drainable louvers prevent entry of rain and snow.
- K. Interior Lights with Switch: Factory-wired, vaporproof luminaires within housing; arranged to illuminate controls and accessible interior. Arrange for external electrical connection.
 - 1. AC lighting system and connection point for operation when remote source is available.
- L. Convenience Outlets: Factory-wired, GFCI. Arrange for external electrical connection.

2.10 VIBRATION ISOLATION DEVICES

- A. 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.
 - 1. Material: Standard neoprene separated by steel shims.
- B. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
 - 1. 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 1/4-inch-thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment-mounting and -leveling bolt that acts as blocking during installation.
 - 2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Minimum Deflection: 1 inch.
- C. Vibration isolation devices shall not be used to accommodate misalignments or to make bends.

2.11 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.12 SOURCE QUALITY CONTROL

- A. Project-Specific Equipment Tests: Before shipment, factory test engine generator and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
 - 1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
 - 2. Test generator, exciter, and voltage regulator as a unit.

- 3. Full load run.
- 4. Maximum power.
- 5. Voltage regulation.
- 6. Transient and steady-state governing.
- 7. Single-step load pickup.
- 8. Safety shutdown.
- 9. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
- 10. Report factory test results within 10 days of completion of test.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine generator performance.
- B. Examine roughing-in for piping systems and electrical connections. Verify actual locations of connections before packaged engine generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Architect no fewer than 7 working days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.

3.03 INSTALLATION

- A. Comply with NECA 1 and NECA 404.
- B. Comply with packaged engine generator manufacturers' written installation and alignment instructions.
- C. Equipment Mounting:
 - 1. Install packaged engine generators on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 03
 - 2. Coordinate size and location of concrete bases for packaged engine generators Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- D. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- E. Exhaust System: Install Schedule 40 black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet.

3.04 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
 - 1. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in first two subparagraphs below, as specified in NETA ATS. Certify compliance with test parameters.
 - a. Visual and Mechanical Inspection:
 - 1) Compare equipment nameplate data with Drawings and the Specifications.
 - 2) Inspect physical and mechanical condition.
 - 3) Inspect anchorage, alignment, and grounding.
 - 4) Verify that the unit is clean.
 - b. Electrical and Mechanical Tests:
 - 1) Perform insulation-resistance tests according to IEEE 43.

- a) Machines Larger Than 200 hp Test duration shall be 10 minutes. Calculate polarization index.
- b) Machines 200 hp or Less: Test duration shall be one minute. Calculate the dielectric-absorption ratio.
- 2) Test protective relay devices.
- 3) Verify phase rotation, phasing, and synchronized operation as required by the application.
- 4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
- 2. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
 - a. Measure charging voltage and voltages between available battery terminals for fullcharging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
 - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
 - c. Verify acceptance of charge for each element of the battery after discharge.
 - d. Verify that measurements are within manufacturer's specifications.
- 3. Battery-Charger Tests: Verify specified rates of charge for both equalizing and floatcharging conditions.
- 4. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.
- B. Coordinate tests with tests for transfer switches and run them concurrently.
- C. Test instruments shall have been calibrated within the past 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.
- D. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.
- E. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.
- F. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- G. Retest: Correct deficiencies identified by tests and observations, and retest until specified requirements are met.
- H. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- I. Infrared Scanning: After Substantial Completion, but not more than 60 days after final acceptance, perform an infrared scan of each power wiring termination and each bus connection while running with maximum load. Remove all access panels so terminations and connections are accessible to portable scanner.
 - 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.
 - 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 3. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 MAINTENANCE SERVICE

3.06 **DEMONSTRATION**

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

END OF SECTION
SECTION 26 3600

TRANSFER SWITCHES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Contactor-type automatic transfer switches.
 - 2. Transfer switch accessories.

1.03 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 transfer switches.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
 - 2. Include material lists for each switch specified.
 - 3. Single-Line Diagram: Show connections between transfer switch, power sources, and load; and show interlocking provisions for each combined transfer switch and.

1.04 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Data: Certificates, for transfer switches, 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. 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.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 01, include the following:
 - a. Features and operating sequences, both automatic and manual.
 - b. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.06 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 12 months from date of Substantial Completion.

PART 2 PRODUCTS

2.01 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.
- B. Comply with NEMA ICS 1.

- C. Comply with NFPA 110.
- D. Comply with UL 1008 unless requirements of these Specifications are stricter.
- E. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- F. Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
- G. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- H. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- I. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electricmotor-operated mechanism. Switches for emergency or standby purposes shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.
- J. Neutral Switching: Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.
- K. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable with printed markers at terminations. Color-coding and wire and cable markers are specified in Section 26 05 53 "Identification for Electrical Systems."
 - 1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
 - 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
 - 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
 - 4. Accessible via front access.
- L. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.02 CONTACTOR TYPE AUTOMATIC TRANSFER SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Asco.
 - 2. Caterpillar, Inc.; Electric Power Division.
 - 3. Cummins Power Generation.
 - 4. Generac.
- B. Comply with Level 1 equipment according to NFPA 110.
- C. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 - 1. Switch Action: Double throw; mechanically held in both directions.
 - 2. Contacts: Silver composition or silver alloy for load-current switching. Contactor-style automatic transfer-switch units, rated 600 A and higher, shall have separate arcing contacts.
 - 3. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 4. Material: Hard-drawn copper, 98 percent conductivity.
 - 5. Main and Neutral Lugs: Mechanical type.
 - 6. Ground bar.
 - 7. Connectors shall be marked for conductor size and type according to UL 1008.
- D. Automatic Closed-Transition Transfer Switches: Connect both sources to load momentarily. Transition is controlled by programming in the automatic transfer-switch controller.

- 1. Fully automatic make-before-break operation when transferring between two available power sources.
- 2. Load transfer without interruption, through momentary interconnection of both power sources not exceeding 100 ms.
- 3. Initiation of No-Interruption Transfer: Controlled by in-phase monitor and sensors confirming both sources are present and acceptable.
 - a. Initiation occurs without active control of generator.
 - b. Controls ensure that closed-transition load transfer closure occurs only when the two sources are within plus or minus 5 electrical degrees maximum, and plus or minus 5 percent maximum voltage difference.
- 4. Failure of power source serving load initiates automatic break-before-make transfer.
- E. Manual Switch Operation, Load-Breaking: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
- F. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval shall be adjustable from 1 to 30 seconds.
- G. Automatic Transfer-Switch Controller Features:
 - 1. Controller operates through a period of loss of control power.
 - 2. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
 - 3. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
 - 4. Test Switch: Simulate normal-source failure.
 - 5. Switch-Position Pilot Lights: Indicate source to which load is connected.
 - 6. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
 - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
 - 7. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
 - 8. Transfer Override Switch: Overrides automatic retransfer control so transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
 - 9. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
 - 10. Engine Shutdown Contacts:
 - a. Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
 - 11. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
 - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
 - b. Push-button programming control with digital display of settings.
 - c. Integral battery operation of time switch when normal control power is unavailable.

- H. Large-Motor-Load Power Transfer:
 - 1. In-Phase Monitor: Factory-wired, internal relay controls transfer so contacts close only when the two sources are synchronized in phase and frequency. Relay shall compare phase relationship and frequency difference between normal and emergency sources and initiate transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer shall be initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.

2.03 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect components, assembled switches, and associated equipment according to UL 1008. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.
- B. Prepare test and inspection reports.
 - 1. For each of the tests required by UL 1008, performed on representative devices, for emergency systems. Include results of test for the following conditions:
 - a. Overvoltage.
 - b. Undervoltage.
 - c. Loss of supply voltage.
 - d. Reduction of supply voltage.
 - e. Alternative supply voltage or frequency is at minimum acceptable values.
 - f. Temperature rise.
 - g. Dielectric voltage-withstand; before and after short-circuit test.
 - h. Overload.
 - i. Contact opening.
 - j. Endurance.
 - k. Short circuit.
 - I. Short-time current capability.
 - m. Receptacle withstand capability.
 - n. Insulating base and supports damage.

PART 3 EXECUTION

3.01 INSTALLATION

- 1. Comply with requirements for seismic control devices specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."
- 2. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
- 3. Provide workspace and clearances required by NFPA 70.
- B. Set field-adjustable intervals and delays, relays, and engine exerciser clock.
- C. Comply with NECA 1.

3.02 CONNECTIONS

- A. Wiring Method: Install cables in raceways and cable trays except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.
 - 1. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.03 FIELD QUALITY CONTROL

- A. Administrant for Tests and Inspections:
 - 1. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:
 - 1. After installing equipment, test for compliance with requirements according to NETA ATS.

- 2. Visual and Mechanical Inspection:
 - a. Compare equipment nameplate data with Drawings and Specifications.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding, and required clearances.
 - d. Verify that the unit is clean.
 - e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
 - f. Verify that manual transfer warnings are attached and visible.
 - g. Verify tightness of all control connections.
 - h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torquewrench method according to manufacturer's published data.
 - i. Perform manual transfer operation.
 - j. Verify positive mechanical interlocking between normal and alternate sources.
 - k. Perform visual and mechanical inspection of surge arresters.
 - I. Inspect control power transformers.
 - 1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
 - 2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
- 3. Electrical Tests:
 - a. Perform insulation-resistance tests on all control wiring with respect to ground.
 - b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
 - c. Verify settings and operation of control devices.
 - d. Calibrate and set all relays and timers.
 - e. Verify phase rotation, phasing, and synchronized operation.
 - f. Perform automatic transfer tests.
 - g. Verify correct operation and timing of the following functions:
 - 1) Normal source voltage-sensing and frequency-sensing relays.
 - 2) Engine start sequence.
 - 3) Time delay on transfer.
 - 4) Alternative source voltage-sensing and frequency-sensing relays.
 - 5) Automatic transfer operation.
 - 6) Interlocks and limit switch function.
 - 7) Time delay and retransfer on normal power restoration.
 - 8) Engine cool-down and shutdown feature.
- 4. Measure insulation resistance phase-to-phase and phase-to-ground with insulationresistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.
 - d. Perform manual transfer operation.
- 5. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.
 - a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
 - b. Verify time-delay settings.
 - c. Verify pickup and dropout voltages by data readout or inspection of control settings.

- d. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
- e. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for one pole deviating by more than 50 percent from other poles.
- f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
- C. Coordinate tests with tests of generator and run them concurrently.
- D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- E. Transfer switches will be considered defective if they do not pass tests and inspections.
- F. Remove and replace malfunctioning units and retest as specified above.
- G. Prepare test and inspection reports.

3.04 **DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.
- B. Training shall include testing ground-fault protective devices and instructions to determine when the ground-fault system shall be retested. Include instructions on where ground-fault sensors are located and how to avoid negating the ground-fault protection scheme during testing and circuit modifications.
- C. Coordinate this training with that for generator equipment.

END OF SECTION

SECTION 26 5100

LIGHTING FIXTURES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Requirements:
 - 1. Section 26 0923 "Lighting Control Equipment" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
 - 2. Section 26 0924 "Digital Lighting Control Equipment" for manual or programmable control systems with low-voltage control wiring or data communication circuits.

1.02 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp, or luminaire assembly.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires.
 - 4. Include emergency lighting units, including batteries and chargers.
 - 5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
 - 6. Photometric data and adjustment factors based on laboratory tests, complying with IES "Lighting Measurements Testing and Calculation Guides" for each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this project, IES LM-79 and IES LM-80.
- B. Shop Drawings: For nonstandard or custom luminaires.
 - 1. Include plans, elevations, sections, and mounting and attachment details.
 - 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.
- C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.04 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps or LED Modules: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. LED Drivers, Power Supplies or Fixtures with Integral Drivers: Ten for every 100 of each type and ratings installed. Furnish at least one of each type.
 - 3. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 4. Globes and Guards: **O**ne for every 20 of each type and rating installed. Furnish at least one of each type.

1.05 QUALITY ASSURANCE

- A. Provide luminaires from a single manufacturer for each luminaire type.
- B. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.07 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. Warranty Period: **F**ive year(s) from date of Substantial Completion.

PART 2 PRODUCTS

2.01 ACCEPTABLE LUMINAIRES

A. Refer to LUMINAIRE SCHEDULE.

2.02 PERFORMANCE REQUIREMENTS

A. Ambient Temperature: 5 to 104 deg F unless noted otherwise.1. Relative Humidity: Zero to 95 percent.

2.03 LUMINAIRE 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. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps, as needed. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp characteristics:
 - a. "USE ONL " and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI.
- C. RECESSED LUMINAIRES
 - 1. Recessed luminaires shall comply with NEMA LE 4.
 - 2. Supply recessed luminaire complete with trim type required for ceiling system installed. Before ordering, confirm ceiling construction details and architectural finish for each area.
- D. PENDANTS/CABLE HANGERS
 - 1. Swivel sockets permitting normal fixture motion and self-adjustment. Adjustable to provide fixture height alignment.
 - 2. One-piece with matching canopies
 - 3. Fixtures shall be factory counter-weighted and balanced to provide level hanging. Weights shall not be visible.
 - 4. Cable hangers shall be adjustable for a minimum of 12".
- E. LED LUMINAIRES
 - 1. LED light fixtures shall be in accordance with IES, NFPA, UL as shown on the Drawings and as specified.
 - 2. LED light fixtures shall be Reduction of Hazardous Substances (RoHS) compliant.
 - 3. LED drivers shall include the following features unless otherwise indicated:
 - a. Minimum Efficiency: 85% at full load.
 - b. Minimum Operating Ambient Temperature: -20°C (-4°F).
 - 4. Input Voltage: 120-277V (±10%) at 60 Hz.
 - 5. Integral short circuit, open circuit, and overload protection.
 - 6. Power Factor: ≥ 0.95 .
 - 7. Total Harmonic Distortion: $\leq 20\%$.
 - 8. 4-wire (0-10VDC voltage controlled) dimming driver.

- a. Capable of dimming to black from 100% to 1% light output and step to 0%. Driver shall respond similarly when raising from 0% to 100%.
- 9. Driver shall be free from objectionable flicker as measured by flicker index (ANSI/IES RP-16-10).
- 10. LED modules shall include the following features unless otherwise indicated:
 - a. Comply with IES LM-79 and LM-80 requirements.
 - b. Minimum CRI 80 unless otherwise specified in LUMINAIRE SCHEDULE.
 - c. Minimum Rated Life: 50,000 hours per IES L70.
 - d. Light output lumens as indicated in the LUMINAIRE SCHEDULE.
- F. LED Downlights
 - 1. LED drivers, modules, and reflector shall be accessible, serviceable, and replaceable from below the ceiling.
 - 2. Housing, LED driver, and LED module shall be products of the same manufacturer.
- G. LED Troffers:
 - 1. LED drivers, modules, and reflector shall be accessible, serviceable, and replaceable from below the ceiling.
 - 2. Housing, LED driver, and LED module shall be products of the same manufacturer.
- H. E IT Signage:
 - 1. Exit signs will be provided and mounted as indicated on documents and be configured to display egress directional arrows as shown, following NFPA Life Safety Code. On projects without existing or installed standby power, self-powered (battery) options shall be required.
- I. E TERIOR LUMINAIRES AND ACCESSORIES
 - 1. Enclosures: Complete with gaskets to form weatherproof assembly.
 - 2. Provide low temperature ballasts/drivers, which will start reliably at temperatures as low as 0°F.
 - 3. Provide site lighting fixtures with grounding lugs to ground both pole (when provided) and fixture.
 - 4. Provide with damp or wet location labels as noted in "LUMINAIRE SCHEDULE" and as required.
- J. ACCEPTABLE MANUFACTURERS POLES
 - 1. Basis of Design: Hapco.
 - 2. Hadco.
 - 3. Hubbell.
- K. LIGHTING POLES
 - 1. Metal Poles:
 - a. 4" Round, and straight. Provide length that when combined with base structure, will place luminaire at height specified in Luminaire Schedule.
 - b. Steel.
 - c. Anchor base.
 - d. Provide factory painted finish.
 - 2. Wind Load: 100 mph velocity, with luminaires and brackets mounted.
 - 3. Hand Hole:
 - a. Standard size and location as provided by manufacturer. Provide matching gasketed cover plate.
 - 4. Pole Top: Slip-fitter as required.
 - 5. Anchor Bolts: As recommended by pole manufacturer. Provide template, flat washers, lock washer and hex nuts for each pole.
 - 6. Accessories: Provide 4-square deep junction box recessed and welded in pole. Provide continuous 3/4" conduit routed from box out bottom of pole base. Junction box and conduit shall be used for weatherproof fire alarm speaker/strobe and associated wiring. Height of box as specified on Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps, as needed.

3.03 LUMINAIRE SUPPORT

- A. Comply with requirements in Section 26 0529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- D. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

3.04 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, as needed.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Provide support for luminaire without causing deflection of ceiling or wall.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- E. Flush-Mounted Luminaires:
 - 1. Secured to outlet box.
 - 2. All luminaires 12 lbs. or above to be attached directly to ceiling structural members.
 - 3. Trim ring flush with finished surface.
- F. Wall-Mounted Luminaires:
 - 1. Attached to structural members in walls Attached to a minimum 20 gauge backing plate attached to wall structural members Attached using through bolts and backing plates on either side of wall Insert means of attachment .
 - 2. Do not attach luminaires directly to gypsum board.
- G. Suspended Luminaires:
 - 1. Ceiling Mount:
 - a. Two 5/32-inch diameter aircraft cable supports adjustable to 10 feet in length minimum.
 - b. Four-point pendant mount with 5/32-inch diameter aircraft cable supports adjustable to 6 feet in length minimum.
 - c. Hook mount.
 - 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire 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.
- H. Ceiling-Grid-Mounted Luminaires:
 - 1. Secure to any required outlet box.
 - 2. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.
- I. Comply with requirements in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.05 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

3.06 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. 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.

3.07 AD USTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION

SECTION 27 0500

GENERAL COMMUNICATIONS REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE

- A. This section details references, standards, guidelines, requirements and conditions common to all Division 27 and 28 work.
- B. Work under this Section and related sections is subject to requirements of Owner standards and specifications, Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements. Should conflicting requirements occur, the most stringent requirements shall govern unless otherwise approved. The contractor shall notify the Engineer of Record about the conflicting requirements prior to purchasing equipment/materials, and prior to rough-in.
- C. Contractor shall verify all finishes of material and equipment with Architect and Owner prior to purchase or rough-in and immediately inform Engineer of Record regarding any deviations from color or finish contained within Division 27 and 28 specifications.

1.02 DESCRIPTION

- A. Intent of drawings and specifications is to obtain complete systems tested, adjusted, and ready for operation.
- B. Except as otherwise defined in greater detail, terms "provide", "furnish" and "install" as used in Division 27 and 28 contract documents shall have the following meanings:
 - 1. "Provide" or "provided" shall mean "furnish and install".
 - 2. "Furnish" or "furnished" does not include installation.
 - 3. "Install" or "installed" does not include furnishing.
- C. Include incidental details not usually shown or specified, but necessary for proper installation and operation.
- D. Check, verify and coordinate work with drawings and specifications prepared for other trades. Include modifications, relocations, or adjustments necessary to complete work or to avoid interference with other trades.
- E. Included in this contract are connections to equipment provided by others. Refer to Architectural, Electrical, Integrated Automation, Mechanical, Security and final shop drawings for equipment being furnished under other sections for exact locations of outlets and various connections required.
- F. Information given herein and on drawings is as exact as could be secured but is not guaranteed. Do not scale drawings for exact dimensions.
- G. Where architectural features govern location of work, refer to architectural drawings.
- H. Perform work in "neat and workmanlike" manner as defined in ANSI/NECA 1 "Standard Practices for Good Workmanship in Electrical Contracting".

1.03 RELATED WORK

- A. Related Division 27 Sections include:
 - 1. Section 27 0528 Pathways for Communications Systems
 - 2. Section 27 0529 Hangers and Supports for Communications Systems
 - 3. Section 27 1000 Structured Cabling
 - 4. Section 27 1500 Communications Horizontal Cabling
 - 5. Section 27 5129 Two-way Communication System

- B. Related sections in other Divisions of Work:
 - 1. Refer to individual technical sections identified above (if applicable).
 - 2. Section 26 0548 Seismic Controls for Electrical Systems
 - 3. Section 26 0924 Digital Lighting Control Equipment
 - 4. Section 26 2726 Wiring Devices
- **C.** Utility Services:
 - 1. The following services are existing and serve the level 1 MDF, Mech-Elec 103:
 - a. Fiber
 - b. Copper
- D. Temporary Services:
 - 1. Refer to Division 01 Temporary Facilities and Controls.
 - 2. Emergency Communications Coordinate requirements for the following:
 - a. Elevator CAB
 - b. Elevator Lobby Emergency 2-Way Communications
 - c. Fire Alarm Off-Site Monitoring Communications
 - d. Data Network Communications
- E. Continuity of Service:
 - 1. No service beyond project scope shall be interrupted or changed without permission from Architect and Owner. Obtain written permission before work is started.
 - 2. When interruption of services beyond project scope is required, persons concerned shall be notified and shall agree upon a time.
- F. Demolition:
 - 1. Division 01 Selective Demolition.
 - a. Preserve Level 1 systems, fixtures, devices, circuits, and controls to the point of modification of Level 2, 3, and Attic.
 - b. Modify Level 1 only as detailed in contract drawings and documentation.
 - 2. Division 02 Building Demolition.
 - a. Not applicable to this Division of work.
 - 3. Perform demolition as required to accomplish new work.
 - a. Remove abandoned wiring to source of supply or point of re-use.
 - b. Disconnect abandoned outlets and remove devices.
 - c. Remove abandoned outlets if conduit serving then is abandoned and removed.
 - d. Provide blank cover for abandoned outlets that are not removed.
 - e. Disconnect communications systems in walls, floors, and ceilings scheduled for removal.
 - 4. Accomplish work in neat workmanlike manner to minimize interference; annoyance or inconvenience such work might impose on Owner or other contractors.
 - 5. Unless otherwise noted, remove from premises materials and equipment removed in demolition work.
 - 6. Equipment noted to be removed and turned over to Owner shall be delivered to Owner at place and time Owner designates.
 - 7. Where materials are to be turned over to Owner or reused and installed by Contractor, it shall be Contractor's responsibility to maintain condition of materials and equipment equal to that existing before work began. Repair or replace damaged materials or equipment at no additional cost to Owner.
 - 8. Where demolition work interferes with Owner's use of premises, schedule work through Architect, Owner, and with other contractors to minimize inconvenience to Owner. Architect must approve schedule before Contractor begins such work.

- G. Cleaning and repair:
 - 1. Clean and repair existing materials and equipment that remain or will be reused as indicated on drawings.
- H. Concrete Work:
 - 1. Provide cast-in-place concrete as required by contract documents unless otherwise noted.
 - 2. Concrete shall comply with Division 03 Concrete.
 - 3. Provide anchor bolts, metal shapes and templates required to be cast in concrete or used to form concrete for support of equipment.
- I. Painting:
 - 1. Furnish equipment with factory applied prime finish unless otherwise specified.
 - 2. If factory finish on equipment furnished by Contractor is damaged in shipment or during construction, refinish equipment to satisfaction of Engineer.
 - 3. Furnish one can of touch up paint for each factory finish, which will be final finished surface of product.
 - 4. Contractor is responsible for painting of plywood in Telecommunications Equipment Rooms. Refer to Drawings and specifications for additional requirements.

1.04 REQUIREMENTS OF REGULATORY AGENCIES

A. Rules and regulations of Federal, State and local authorities and utility companies, in force at time of execution of contract shall become part of this specification.

1.05 REFERENCES AND STANDARDS

- A. Design, cable and component selection, and installation practices shall conform with following:
 - 1. 2021 Oregon Electrical Specialty Code
 - 2. 2022 Oregon Structural Specialty Code
 - 3. 2022 Oregon Mechanical Specialty Code
 - 4. Country, state and local health, safety and building codes
 - 5. UL 444 Communications Cables
 - 6. Standards identified in individual Technical Sections.
 - 7. BICSI Telecommunications Distribution Methods Manual (TDMM), 14th Edition
 - 8. TIA 568.0-D through.4-D Commercial Building Telecommunications Cabling Standard (including applicable Addenda)
 - 9. TIA 569-E Commercial Building Standard for Telecommunications Pathways and Spaces
 - 10. TIA 606-C Administration Standard for Commercial Telecommunications Infrastructure
 - 11. TIA 607-D Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
 - 12. IEEE 241 IEEE Recommended Practice for Electric Power Systems in Commercial Buildings
- B. Agencies or publications referenced herein refer to the following:
 - 1. ANSI American National Standards Institute
 - 2. ASME American Society of Mechanical Engineers
 - 3. ASTM American Society for Testing and Materials
 - 4. BICSI Building Industry Consulting Services International
 - 5. FIPS Federal Information Processing Standards
 - 6. FCC Federal Communications Commission
 - 7. ICEA Insulated Cable Engineers Association
 - 8. IEEE Institute of Electrical and Electronics Engineers
 - 9. NEC National Electrical Code
 - 10. NECA National Electrical Contractors Association
 - 11. NEMA National Electrical Manufacturers Association

- 12. NESC National Electrical Safety Code
- 13. NETA National Electrical Testing Association
- 14. NFPA National Fire Protection Association
- 15. NIST National Institute of Standards and Technology
- 16. OSHA Occupational Safety and Health Administration
- 17. TIA Telecommunications Industry Association
- 18. UL Underwriters Laboratories, Inc.
- C. Work shall be in accordance with latest edition of codes, standards or specifications unless noted otherwise.

1.06 DEFINITIONS

- A. The following definitions are applicable to communications environments and shall apply to this document and its companion sections for clarification and direction.
 - 1. Entrance facility (EF) an entrance to building for both public and private network service cables and/or wireless services including entrance point of building are terminated. Service provider(s) point-of-demarcation (DEMARC) is typically located here and continue to Equipment Room, Main Connect, or Main Distribution Frame (MDF).
 - 2. Equipment Room (Telecom): an environmentally controlled centralized space for telecommunications equipment that usually houses main or intermediate cross-connect. Backbone cabling, cabling from Building Entrance Facility, and horizontal cabling may be terminated here.
 - 3. Guarantee promise or an assurance that attests to quality or durability of product or service or that task will be performed in specified manner. Used interchangeably with "Warranty" in these documents.
 - 4. Intra-building within single building.
 - 5. Inter-building between 2 or more buildings.
 - 6. IP Telephony Use of Internet Protocol (IP) for two-way transmission of conversations. Sometimes referred to as "Voice over Internet Protocol (VoIP)".
 - 7. Rack Unit standard measurement of vertical mounting space on an equipment rack. Each Rack Unit is 1-3/4 inches high.
 - 8. Voice over Internet Protocol Refer to IP Telephony.
- B. Typical NEMA Enclosures and Usage
 - 1. Refer to Section 26 0000 General Electrical Requirements.
 - 2. NEMA 3R Outdoors. Rain, snow, sleet
 - 3. NEMA 4 Indoor/Outdoor, Protection against falling/windblown dust and dirt, Ingress of dripping/splashing/hose-stream water, rain, snow, and sleet
 - 4. NEMA 4 Same as NEMA 4 plus corrosion resistant

1.07 ABBREVIATIONS AND ACRONYMS

- A. The following abbreviations and acronyms shall apply to this document and its companion sections for clarification and direction.
 - 1. AFF Above Finished Floor
 - 2. ATM Asynchronous Transfer Mode
 - 3. AWG American Wire Gauge
 - 4. BAS Building Automation Systems
 - 5. BTU British Thermal Unit
 - 6. CATV Community Antenna Television
 - 7. CCTV Closed-Circuit Television
 - 8. CDDI Copper Distributed Data Interface (Cisco Systems trade name for TP-PMD)
 - 9. Cm centimeters
 - 10. °C degrees Celsius
 - 11. °F degrees Fahrenheit

- 12. DTMF Dual Tone Multi Frequency
- 13. EIA Electronic Industries Alliance
- 14. EF Entrance Facility
- 15. ER Entrance Room
- 16. EIDF Equipment Intermediate Distribution Facility
- 17. FDDI Fiber Distributed Data Interface
- 18. Ft feet
- 19. GbE Gigabit Ethernet
- 20. Hz Frequency in Hertz (k kilo, M Mega, G Giga)
- 21. ID Inside Diameter
- 22. In inch
- 23. IPT IP Telephony
- 24. Kg kilogram
- 25. lbs pounds
- 26. LAN Local Area Network
- 27. MATV Master Antenna Television
- 28. MC Main Cross-connect
- 29. M meters
- 30. mm millimeters
- 31. Mbps Megabits per second
- 32. µm micrometer (10-6 meter)
- 33. OD Outside Diameter
- 34. PB Private Branch Exchange (Telephone Switch)
- 35. pF pico-Farad (10-12 Farad)
- 36. PVC Polyvinyl Chloride
- 37. RU Rack Unit
- 38. sq ft square feet (area)
- 39. TP-PMD Twisted Pair Physical Medium Dependent
- 40. WAN Wide Area Network
- 41. WLAN Wireless Local Area Network
- 42. VoIP Voice over Internet Protocol
- B. Refer also to technical sections for additional terminology.

1.08 LISTING

A. Refer to technical sections of this Division of work for listing requirements.

1.09 SUBMITTALS

- A. Submit shop drawings for equipment provided under this Section:
 - 1. Refer to Division 01 Submittal Procedures.
 - 2. Note that for satisfying submittal requirements for Division 27 and 28, "Product Data" is usually more appropriate than true "Shop Drawings" as defined in Division 01. However, expression "Shop Drawings" is generally used throughout specification. Refer to detailed specifications pertaining to specific systems (e.g., Overhead Paging, Fire Alarm System, etc.) for additional shop drawing requirements.
 - 3. Mark catalog sheets and drawings to indicate specific items submitted.
 - a. Markings shall be reproducible (e.g., arrow, boxed, encircled, checkmark).
 - b. Where sheet includes multiple product options, mark proposed option(s).
 - 4. Include proper identification of equipment by name and/or number, as indicated in specification and shown on drawings.
 - 5. When manufacturer's reference numbers are different from those specified, provide correct cross-reference number for each item. Mark and annotate submittals accordingly.

- 6. Group submittals by Section to include complete documentation of related systems, products and accessories. Where applicable, dimensions shall be marked in units to match those specified.
- 7. Submittals shall be in electronic form per Division 01.
 - a. Documents in electronic form shall be ADOBE Acrobat PDF.
 - b. Paper documents shall be original catalog sheets or photocopies thereof.
 - c. Facsimile (fax) sheets will not be accepted.
- 8. Engineer's Review is to confirm compliance with performance, interoperability, physical, and other pertinent requirements of project. Review is not to confirm quantities nor that all required items have been submitted.
- 9. When equipment and items specified include accessories, parts and additional items under one designation, submittals shall be complete and include required components.
- 10. Include wiring diagrams for electrically powered or controlled equipment.
- 11. Submit equipment room layouts drawn to scale, including equipment, raceways, accessories and clearance for maintenance.
- 12. Where submittals cover products containing potentially hazardous non-metallic materials, include "Material Safety Data Sheet" (MSDS) from manufacturer stating physical and chemical properties of components and precautionary considerations required.
- 13. Submit shop drawings or product data as soon as practicable after signing contracts. Submittals must be approved before installation of materials and equipment.
- 14. Submittals, which are not complete, not permanent, or not properly checked by Contractor, will be returned without review.
- 15. "Coordination Drawings", which are normally prepared by Contractor to coordinate work among various trades and to facilitate installation, shall not be submitted for Division 27 and 28 work unless specifically requested in technical sections. These types of drawings typically include dimensioned piping, ductwork, communications and/or electrical raceway layouts.
 - a. Unless specifically requested in Division 27 and 28 technical sections, submittals of coordination drawings will be returned without review.
- B. Certificates and Inspections:
 - 1. Obtain and pay for inspections required by authorities having jurisdiction and deliver certificates approving installations to Owner unless otherwise directed.
- C. Operation and Maintenance Manuals:
 - 1. Refer to Division 01 Operation and Maintenance Data.
 - 2. Upon completion of work but before final acceptance of system, submit to Architect for approval, three copies of operation and maintenance manuals in loose-leaf binders. If "one copy" is larger than two inches thick or consists of multiple volumes, submit only one set initially for review. After securing approval, submit three copies to Owner.
 - 3. Manuals shall be organized by specification section number and shall have table of contents and tabs for each piece of equipment or system.
 - 4. Manuals shall include the following:
 - a. Copies of shop drawings
 - b. Manufacturer's operating and maintenance instructions. Include parts lists of items or equipment. Where manufacturer's data includes several types or models, applicable type or model shall be designated.
 - c. CD ROM's of O&M data with exploded parts lists where available
 - d. Phone numbers and addresses of local parts suppliers and service companies
 - e. Internet/WEB page addresses where applicable
 - f. Wiring diagrams
 - g. Start up and shut down procedure
 - h. Factory and field test records

- i. Additional information, diagrams or explanations as designated under respective equipment or systems specification section.
- 5. Instruct Owner's representative in operation and maintenance of equipment. Instruction shall include complete operating cycle on all apparatus.
- 6. O&M manuals and instructions to Owner shall be provided prior to request for final payment.
- D. Record Documents:
 - 1. Refer to General Conditions of Contract, and Division 01 Closeout Procedures. Prepare complete set of record drawings in accordance with Division 01.
 - 2. Provide detailed project record documentation within 30 days of substantial completion of the work.
 - a. Maintain separate sets of red-lined record drawings for the communications work which show the exact placement and identification of as-built system components.
 - b. Provide communication pathway record drawings which indicate exact placement and routing for all components, e.g., maintenance holes, handholes, conduit, wireway, cable tray, pull boxes, enclosures, telecommunications outlet boxes, etc.
 - c. Provide communication room record drawings which indicate exact placement for all components; e.g., conduit, wireway, cable tray, backboards, equipment cabinets, equipment racks, cross-connect equipment, etc.
 - d. Provide communication wiring and cabling record "As-Builds" drawings and schedules which indicate exact placement, routing, and connection details for all components, e.g., twisted-pair and fiber optic cables, splices, cable cross-connect termination locations, enclosures, telecommunications outlets, cross-connect jumpers, patch cords, etc.
 - e. Provide network schematics when appropriate.

1.10 OB CONDITIONS

- A. Building Access:
 - 1. Arrange for necessary openings in building to allow for admittance of all apparatus.
- B. Cutting and Patching:
 - 1. Refer to General Conditions of Contract, and Division 01 Cutting and Patching.
 - 2. Perform cutting and patching required for complete installation of systems unless otherwise noted. Patch and restore work cut or damaged to original condition. This includes openings remaining from removal or relocation of existing system components.
 - 3. Provide materials required for patching unless otherwise noted.
 - 4. Do not pierce beams or columns without permission of Architect and then only as directed. If openings are required through walls or floors where no sleeve has been provided, hole shall be core drilled to avoid unnecessary damage and structural weakening.
 - 5. Where alterations disturb lawns, paving, walks, etc., replace, repair or refinish surfaces to condition existing prior to commencement of work. This may include areas beyond construction limits.
- C. Housekeeping and Cleanup:
 - 1. Refer to Division 01 Closeout Procedures.
 - 2. Periodically as work progresses and/or as directed by Architect, remove waste materials from building and leave area of work broom clean. Upon completion of work, remove tools, scaffolding, broken and waste materials, etc. from site.

1.11 DIVISION OF WORK BETWEEN OWNER AND CONTRACTORS

- A. All material, products, and labor not specifically designated in this section shall be CFCI.
- B. Active electronics for interface with building voice and data cabling systems (e.g., switches, routers, servers, firewalls, etc.): OFOI.

- C. Wireless Access Points: OFCI.
- D. Wireless Access Point Enclosures: CFCI.
- E. Wireless Access Point Remote Antenna: CFCI.
- F. Patch cable connections from telephone and data equipment to Horizontal or Backbone cabling: CFCI.
- G. Patch cable Cross Connections from Level 1 Backbone cabling to Level 2 Backbone cabling: CFCI.
- H. Backbone cabling: CFCI.
- I. Horizontal cabling: CFCI.
- J. Telecom Outlet Faceplates, Jacks, Terminations, and Testing: CFCI.
- K. Connections from Backbone Voice Cables to Horizontal Voice Cables including 110 blocks, 110 protector blocks, and patch panels: CFCI.
- L. Passive Broadband distribution hardware (coaxial cable taps and splitters): CFCI.
- M. Active Broadband headend and distribution hardware (e.g., video processing, distribution amplifiers): CFCI.
- N. Telecom Room Equipment Racks and/or Cabinets: CFCI.
- O. Telecom Room cable management (e.g., vertical cable managers for racks, cable runway): CFCI.
- P. Conduit and sleeve penetration firestopping: CFCI.
- Q. Firestop cables exiting conduit stubs and sleeves: CFCI.

1.12 QUALITY ASSURANCE

A. Refer to the individual technical sections for specific product quality requirements, manufacturer qualifications, and contractor qualifications and certification requirements.

1.13 GUARANTEE

- A. Refer to Division 01 for general Guarantee (Warranty) requirements.
- B. Refer to technical sections for Guarantee requirement for each system.
- C. Where no guarantee requirements are called out, guarantee for one year after acceptance by Owner shall include equipment, materials, and workmanship to be free from defect.
- D. Repair, replace or alter systems or parts of systems found defective at no extra cost to Owner.
- E. Wherein fulfilling requirements of any guarantee, if Contractor disturbs any work guaranteed under another contract, restore such disturbed work to condition satisfactory to Architect and guarantee such restored work to same extent as it was guaranteed under such other contract.
- F. Guarantees shall include labor, material and travel time.

PART 2 PRODUCTS

2.01 PRODUCT SUBSTITUTIONS

- A. Refer to Division 01 Product Requirements.
- B. Refer to technical sections for substitution requirements for each system.

PART 3 EXECUTION

3.01 GENERAL

A. Verify elevations and measurements prior to installation of materials.

3.02 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Division 01.
- B. Store and protect products under provisions of Division 01.
- C. Store in clean, dry space.
- D. Maintain factory wrapping or provide cover to protect units from dirt, water, construction debris, and traffic.
- E. Handle in accordance with manufacturer's written instructions.
- F. Handle carefully to avoid damage to components, enclosure, and finish. Lift only with lugs provided for the purpose.

3.03 FLOOR, WALL, ROOF AND CEILING OPENINGS

- A. Coordinate location of openings, chases, furred spaces, etc. with appropriate Contractors. Provide during progress of construction sleeves and inserts that are to be built into structure.
- B. Temporary sleeves, if used to form wall openings, shall be removed prior to installation of permanent materials. Permanent sleeves for wall penetrations shall be minimum 24-gauge galvanized sheet metal unless otherwise noted.
- C. Steel sleeves, when required, shall be Schedule 40 carbon steel pipe with integral water stop.
- D. Submit product data and installation details for penetrations of building structure. Submittal shall include schedule indicating penetrating materials, (including steel conduit, PVC conduit, cables, cable tray), sizes of each, opening sizes and sealant products intended for use.
- E. Where penetrations of fire-rated assemblies are involved, seal penetrations with appropriate firestopping systems as specified in Division 26.
- F. Openings for penetrations shall be minimum ½-inch larger on all sides than outside dimensions of raceways or cables. However, where fire resistant penetrations are required, size openings in accordance with the requirements of a UL listed firestopping system required to restore the fire rating of the penetrated assembly.
- G. Seal non-fire-rated floor penetrations with non-shrink grout equal to Embeco by Master Builders, or urethane caulk, as appropriate.
- H. Seal non-fire-rated wall openings with urethane caulk.
- I. Finish and trim penetrations as shown on details and as specified hereinafter.

3.04 EQUIPMENT ACCESS

- A. Install raceways, junction and pull boxes, and accessories to permit access to equipment for maintenance. Relocation of raceways, or accessories as required to provide access, shall be provided at no additional cost to Owner.
- B. Install equipment with ample space allowed for removal, repair or changes to equipment. Provide ready accessibility to equipment and wiring without moving other equipment, which is to be installed or which is already in place.
- C. Access doors in walls, chases, or inaccessible ceilings will be provided under Division 08 -Access Doors and Frames, unless otherwise indicated. Access doors shall be for purpose of providing access where equipment requiring servicing, repairs or maintenance is located in walls, chases, above inaccessible ceilings, and top of elevator shafts.
- D. Locate communications outlets and equipment to fit details, panels, decorating or finish at space. Architect reserves right to make minor position changes of outlet locations prior to rough-in.

E. Verify room door swings before installing wall-mounted communications outlets and install boxes on latch side of door unless otherwise noted.

3.05 EQUIPMENT SUPPORTS

- A. Provide supporting steel not indicated on drawings as required for installation of equipment and materials including angles, channels, beams, hangers.
- B. Concrete anchors, used for attachment to concrete, shall be steel shell with plug type. Plastic, rawhide or anchors utilizing lead are not allowed.
- C. Do not support equipment or cable pathways from metal roof decking.

3.06 SUPPORT PROTECTION

- A. In occupied areas, mechanical rooms and areas requiring normal maintenance access, certain equipment must be guarded to protect personnel from injury.
- B. Provide minimum ½-inch thick Armstrong Armaflex insulation or similar product applied with Armstrong 520 adhesive on lower edges of equipment, including bus duct, cable tray, pull boxes and electrical supporting devices suspended less than seven feet above floors, platforms or catwalks in these areas.
- C. Threaded rod or bolts shall not extend beyond supporting element and shall be protected as described above.

3.07 CABLE PROTECTION

- A. Protect cabling and termination components from contact with, and potential application of, foreign materials.
 - 1. Foreign material is defined as material that is not part of cabling assembly and termination components when delivered from manufacturer.
 - 2. Examples include paint overspray and drywall compound.
- B. Cabling and components that come into contact with foreign materials shall be replaced at no cost to project.
 - 1. Solvents and other cleaning agents shall not be used to remove foreign materials that have already accumulated on cabling and components.

3.08 LEAD SHIELDING

A. Not applicable to project.

3.09 ACCEPTANCE TESTING

- A. Prior to testing, submit to owner (or Owner's representative) and Engineer, proposed schedule for acceptance testing.
 - 1. This notification shall be minimum of 10 working days in advance to allow for participation by Owner and/or Engineer.
- B. Prior to testing, submit written description of intended test procedures and submit sample test forms to Engineer.
 - 1. Submitted information shall include proposed file naming format to be used in identifying cable, pair or optical fiber which is subject of test record.
 - 2. Failure to provide above information shall be grounds for Engineer or Owner to reject any Documentation of related testing and to require repeat of affected test.
- C. Conduct tests during course of construction when identifiable portion(s) of installation is complete.
 - 1. Alternatively, testing can be conducted after entire installation is complete if this does not delay project schedule.
- D. Provide equipment and personnel necessary to conduct acceptance tests.

- E. Testing shall be completed and accepted by Owner and Engineer before Owner furnished equipment and cross connects are installed.
- F. Document tests.
- G. When equipment or systems fail to meet minimum test requirements, replace or repair defective work or materials as necessary and repeat inspection and test. This shall be at no additional cost to the owner. Replacement materials shall be new.
- H. This Contractor is responsible for certifying, in writing, equipment and system test results. Certification shall include identification of portion of system tested, date, time, test criteria and name and title of person signing test certification documents.
- I. Maintain copies of certified test results, including those for failed tests, at project site. At completion of project, include copies of test records and certifications in O&M Manuals.

3.10 START UP

- A. Systems and equipment shall be started, tested, adjusted and turned over to Owner ready for operation.
 - 1. This includes "Owner-Furnished, Contractor-Installed" (OFCI) and "Contractor-Furnished, Contractor-Installed" (CFCI) systems and equipment.
- B. Follow manufacturer's pre-start-up checkout, start-up, trouble shooting and adjustment procedures.
- C. Contractor shall provide services of technician/installer knowledgeable in start-up and checkout of types of systems and equipment on project.
- D. Provide start-up services, by manufacturer's representative where specified or where Contractor does not have qualified personnel.
- E. Coordinate start-up with trades.

3.11 DOCUMENTATION

- A. Upon completion of installation, Contractor shall provide System Documentation. Documentation shall include:
 - 1. Acceptance Test Results
 - 2. Record Drawings
 - 3. All Approved Submittals
 - 4. Manufacturer's Warranty Documents
- B. Submit System Documentation in accordance with Division 01 "Project Record Documents".
 - 1. Documents shall be submitted in same electronic format in which they were received from Architect and Engineer.
 - 2. Document updates shall be performed in native software format matching original design team documents.
 - a. Scans of hand marked documents shall not be accepted.
 - 3. Update documents to reflect installed conditions for equipment shown on documents.
- C. Submit documentation within ten (10) working days of the completion of testing of each testing phase (e.g. subsystem, cable type, area, floor) or 3 weeks prior to scheduled occupancy of subject area, whichever is sooner. This is inclusive of Test Result and draft Record Drawings.
 - 1. Draft drawings may include mark-ups done by hand.
 - 2. Machine generated (final) copies of Record Drawings shall be submitted within 30 working days of completion of each testing phase.
 - 3. Documentation will include all aspects of systems covered by these specifications that are required for systems to be fully functional.

- 4. For structured cabling this includes the horizontal link from the TO to the HC, backbone cabling from the HC to the MC, cross-connections, interconnections and/or patch cords that are the responsibility of the contractor.
- D. Submit Acceptance Test Results for all Contractor provided Systems in electronic form for review and distribution.
 - 1. Interim documentation of Test Results (if applicable) may be submitted via email or on thumb drive.
 - 2. Final documentation of Test Results shall be submitted on thumb drive.
 - 3. Test results shall be submitted in format(s) native to test instrument(s) used in performing testing.
 - 4. Where unique software (other than an MS-Word← compatible Word Processor or MS-Excel← spreadsheet) is required for viewing of test results, Contractor shall provide along with above documentation, one (1) licensed copy of such software. Software shall run on MICROSOFT Windows-based personal computer.
- E. Acceptance Test results shall include description of sub-system tested, equipment/cable/outlet I.D., reference and test setup, test equipment type/model and serial number(s), equipment location and direction of test (if applicable), test frequencies/wavelengths, date and operator name(s).
- F. Engineer or Owner may request that 10% random re-test be conducted on cable system at no additional cost to verify documented findings. Tests shall be a repeat of those defined above and in technical sections.
 - 1. Owner may also perform independent testing to verify results.
 - 2. If findings contradict documentation submitted by Contractor, additional testing can be requested to extent determined necessary by Engineer or Owner, including 100% re-test. This re-test shall be at no additional cost to Owner.
- G. Documentation including hard copy and electronic forms of Test Data and Record Drawings shall become property of Owner.
- H. Refer also to Technical Sections for requirements specific to covered subsystems.

3.12 CLEANING

- A. After installation is complete, Contractor shall clean all systems.
- B. Vacuum debris from system components, enclosures, junction boxes and pull boxes prior to testing and again prior to completion.
- C. Thoroughly clean equipment of stains, paint spots, dirt and dust. Remove temporary labels not used for instruction or operation.

END OF SECTION

SECTION 27 0526

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 SCOPE

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. This section includes product and execution requirements for items unique to communications and not included in Division 26 sections.
- C. Refer to Section 27 05 00 General Communications Requirements.

1.02 RELATED WORK

- A. Related Division 27 Sections include:
 - 1. Section 27 0500 General Communications Requirements
 - 2. Section 27 0533 Raceway and Boxes for Communications Systems
 - 3. Section 27 0536 Cable Tray for Communications Systems
 - 4. Section 27 1000 Structured Cabling
 - 5. Section 27 1100 Communications Equipment Room Fittings
 - 6. Section 27 1300 Communications Backbone Cabling
 - 7. Section 27 1500 Communications Horizontal Cabling
- B. Related sections in other Divisions of Work:
 - 1. Section 26 0526 Grounding and Bonding for Electrical Systems

1.03 REFERENCES AND STANDARDS

- A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.
- B. Work under this Section is subject to the references and standards requirements of Section 27 0500 General Communications Requirements.
 - 1. Additional Standards:
 - 2. IEEE/ANSI 142 Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 - 3. UL 467 Électrical Grounding and Bonding Equipment
 - 4. TIA 607-D Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
- C. Abbreviations and Acronyms
 - 1. BCT: Bonding conductor for telecommunications.
 - 2. SP/ISP: Service Provider/Internet Service Provider: The operator of a service that provides telecommunications/internet transmission delivered over access provider facilities.
 - 3. TGB: Telecommunications grounding busbar.
 - 4. TMGB: Telecommunications main grounding busbar.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.05 INFORMATIONAL SUBMITTALS

- A. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:
 - 1. Ground rods.
 - 2. Ground and roof rings.
 - 3. BCT, TMGB, TGBs, and routing of their bonding conductors.

- B. Qualification Data: For Installer, installation supervisor, and field inspector.
- C. Qualification Data: For testing agency and testing agency's field supervisor.
- D. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Division 01, include the following:
 - a. Result of the ground-resistance test, measured at the point of BCT connection.
 - b. Result of the bonding-resistance test at each TGB and its nearest grounding electrode.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Installation Supervision: Installation shall be under the direct supervision of ITS designated installer who shall be present at all times when Work of this Section is performed at Project site.
 - 2. Field Inspector: Currently registered by BICSI as a designer RCDD or Technician as designated by owner to perform the on-site inspection.

PART 2 PRODUCTS

2.01 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.
- C. Comply with TIA-607-B.

2.02 CONDUCTORS

- 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. Panduit Corp.
 - 2. TE Connectivity Ltd.
- B. Comply with UL 486A-486B.
- C. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
 - 1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
 - 2. Cable Tray Equipment Grounding Wire: No. 6 AWG.
- D. Cable Tray Grounding Jumper:
 - 1. Not smaller than No. 6 AWG and not longer than 12 inches. If jumper is a wire, it shall have a crimped grounding lug with two holes and long barrel for two crimps. If jumper is a flexible braid, it shall have a one-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
- E. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmils, 14 strands of No. 17 AWG conductor, and 1/4 inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.03 CONNECTORS

- A. Mechanical Connectors
 - 1. Connector Body shall:
 - a. Be high-strength, high-conductivity cast copper alloy
 - b. Be 2 bolt type
 - 2. Bolts, nuts, washers and lock-washers: Silicon Bronze
 - a. Shall be supplied as part of connector body
 - b. Split bolt connector types are not allowed
 - 3. Connector shall:
 - a. Meet or exceed UL 467
 - b. Be clearly marked with catalog number, conductor size and manufacturer.
- B. Compression Connectors
 - 1. Connector Body: pure wrought copper.
 - a. Conductivity shall be no less than 99% by IACS standards.
 - 2. Connector shall:
 - a. Meet or exceed performance requirements of IEEE 837, latest revision
 - b. Be factory filled with an oxide-inhibiting compound
 - c. Be clearly marked with manufacturer, catalog number, conductor size and required compression tool settings
 - 3. Connection shall be irreversible.
- C. Exothermic Weld Connections
 - 1. Not Allowed

2.04 GROUNDING BUSBARS

- 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. Chatsworth Products, Inc.
 - 2. Panduit Corp.
- B. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 20" x 4" x 1/4". The busbar shall be NRTL listed for use as TMGB and shall comply with TIA-607-D.
 - 1. Predrilling shall be with holes for use with 2-hole lugs specified in this Section.
 - 2. Mounting Hardware: Stand-off brackets that provide a 4-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
 - 3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- C. TGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 12" x 2" x 1/4". The busbar shall be NRTL listed for use as TGB and shall comply with TIA-607-D.
 - 1. Predrilling shall be with holes for use with 2-hole lugs specified in this Section.
 - 2. Mounting Hardware: Stand-off brackets that provide at least a 4-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
 - 3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- D. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with TIA-607-B. Predrilling shall be with holes for use with lugs specified in this Section.
 - 1. Cabinet-Mounted Busbar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.

- 2. Rack-Mounted Horizontal Busbar: Designed for mounting in 19- or 23-inch equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.
- 3. Rack-Mounted Vertical Busbar: 72 or 36 inches long, with stainless-steel or copper-plated hardware for attachment to the rack.

2.05 IDENTIFICATION

A. Comply with requirements for identification products in Section 27 05 53 – Identification for Communications Systems.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

- A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.
- B. Comply with NECA 1.
- C. Comply with TIA-607-B.

3.03 APPLICATION

- A. Conductors: Install stranded conductors for No. 6 AWG and larger unless otherwise indicated.
 - 1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
 - 2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2 AWG minimum.
- C. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.
- D. Conductor Support:
 - 1. Secure grounding and bonding conductors at intervals of not less than 36 inches.
- E. Grounding and Bonding Conductors:
 - 1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
 - 2. Install without splices.
 - 3. Support at not more than 36-inch intervals.

- 4. Install grounding and bonding conductors in 3/4-inch PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
 - a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 27 05 28 Pathways for Communications Systems and bond both ends of the conduit to a TGB.

3.04 GROUNDING ELECTRODE SYSTEM

A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than No. 3/0 AWG.

3.05 GROUNDING BUSBARS

- A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches minimum from wall, 12 inches above finished floor unless otherwise indicated.
- B. 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.

3.06 CONNECTIONS

- A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.
- B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
- C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
 - 1. Use crimping tool and the die specific to the connector.
 - 2. Pre-twist the conductor.
 - 3. Apply an antioxidant compound to all bolted and compression connections.
- D. Primary Protector: Bond to the TMGB with insulated bonding conductor.
- E. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than 2 kcmils/linear foot of conductor length, up to a maximum size of No. 3/0 AWG unless otherwise indicated.
- F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install top-mounted rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB No. 2 AWG bonding conductors.
- G. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.
- H. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of the panelboard.
- I. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.

- J. Towers and Antennas:
 - 1. Ground Ring: Buried at least 30 inches below grade and at least 24 inches from the base of the tower or mounting.
 - 2. Bond each tower base and metallic frame of a dish to the ground ring, buried at least 18 inches below grade.
 - 3. Bond the ground ring and antenna grounds to the equipment room TMGB or TGB, buried at least 30 inches below grade.
 - 4. Bond metallic fences within 6 feet of towers and antennas to the ground ring, buried at least 18 inches below grade.
 - 5. Special Requirements for Roof-Mounted Towers:
 - a. Roof Ring: Meet requirements for the ground ring except the conductors shall comply with requirements in Division 26.
 - b. Bond tower base footings steel, the TGB in the equipment room, and antenna support guys to the roof ring.
 - c. Connect roof ring to the perimeter conductors of the lightning protection system.
 - 6. Waveguides and Coaxial Cable:
 - a. Bond cable shields at the point of entry into the building to the TGB and to the cable entrance plate, using No. 2 AWG bonding conductors.
 - b. Bond coaxial cable surge arrester to the ground or roof ring using bonding conductor size recommended by surge-arrester manufacturer.

3.07 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- B. Comply with IEEE C2 grounding requirements.
- C. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches extends above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, non-shrink grout.
- D. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect grounding conductors to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

3.08 IDENTIFICATION

- A. Labels shall be preprinted or computer-printed type.
 - 1. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.
 - 2. Label TGB(s) with "fs-TGB," where "fs" is the telecommunications space identifier for the space containing the TGB.
 - 3. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT "

3.09 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:

- 1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
- 2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
 - a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.
- 3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.
 - a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB and in each TGB. Maximum acceptable ac current level is 1 A.
- C. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.
- D. Grounding system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION

SECTION 27 0528

PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 SCOPE

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. This section includes product and execution requirements for items unique to communications and not included in Division 26 sections.
- C. Refer to Section 27 05 00 General Communications Requirements.

1.02 RELATED WORK

- A. Related Division 27 Sections include:
 - 1. Section 27 05 00 General Communications Requirements
 - 2. Section 27 05 29 Hangers and Supports for Communications Systems
 - 3. Section 27 05 33 Raceway and Boxes for Communications Systems
 - 4. Section 27 05 36 Cable Tray for Communications Systems
- B. Related sections in other Divisions of Work:
 - 1. Section 26 05 48 Seismic Controls for Electrical Systems

1.03 REFERENCES AND STANDARDS

- A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.
- B. Work under this Section is subject to the references and standards requirements of Section 27 0500 General Communications Requirements.

1.04 ACTION SUBMITTALS

- A. Product data for the following:
 - 1. Surface pathways
 - 2. Wireways and fittings.
 - 3. Boxes, enclosures, and cabinets.
 - 4. Underground handholes and boxes.

1.05 INFORMATIONAL SUBMITTALS

PART 2 PRODUCTS

2.01 METAL CONDUITS AND FITTINGS

- A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Allied Tube & Conduit; Atkore International.
 - 2. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
 - 3. Western Tube; Zekelman Industries.
- C. General Requirements for Metal Conduits and Fittings:
 - 1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
 - 2. Comply with TIA-569-D.
- D. GRC: Comply with ANSI C80.1 and UL 6.
- E. IMC: Comply with ANSI C80.6 and UL 1242.
- F. EMT: Comply with ANSI C80.3 and UL 797.
- G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 - 1. Fittings for EMT:
 - a. Material: Steel.

- b. Wet Areas
 - 1) Type: compression.
- c. Dry Areas
 - Type: Set screw.
- 2. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions, where installed, and including flexible external bonding jumper.
- H. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.02 NONMETALLIC CONDUITS AND FITTINGS

- A. Description: Nonmetallic raceway of circular section with manufacturer-fabricated fittings.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Allied Tube & Conduit; Atkore International.
 - 2. Cantex Inc.
 - 3. Kraloy Fittings.
- C. General Requirements for Nonmetallic Conduits and Fittings:
 - 1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 - 2. Comply with TIA-569-D.
- D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- E. Rigid HDPE: Comply with UL 651A.
- F. Continuous HDPE: Comply with UL 651A.
- G. RTRC: Comply with UL 2515A and NEMA TC 14.
- H. Fittings: Comply with NEMA TC 3; match to conduit or tubing type and material.
- I. Solvents and Adhesives: As recommended by conduit manufacturer.

2.03 OPTICAL FIBER CABLE PATHWAYS AND FITTINGS

- A. Description: Comply with UL 2024; flexible-type pathway with a circular cross section, approved for riser installation unless otherwise indicated.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Endot Industries Inc.
 - 2. IPE USA LLC.
 - 3. MaxCell.
- C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with TIA-569-D.

2.04 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal trough of rectangular cross section fabricated to required size and shape, without holes or knockouts, and with hinged or removable covers.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. B-line; Eaton, Electrical Sector.
 - 2. Hoffman; nVent.
 - 3. MonoSystems, Inc.
- C. General Requirements for Metal Wireways and Auxiliary Gutters:
 - 1. Comply with UL 870 and NEMA 250, Type 1 unless otherwise indicated and sized according to NFPA 70.

- 2. Metal wireways installed outdoors shall be NEMA Type 3R or 4 as applicable to the application and listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- 3. Comply with TIA-569-D.
- D. 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.
- E. Wireway Covers: Screw-cover type unless otherwise indicated.
- F. Finish: Manufacturer's standard enamel finish.

2.05 SURFACE METAL PATHWAYS

- A. Description: Galvanized steel with snap-on covers, complying with UL 5.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. MonoSystems, Inc.
 - 2. Wiremold; Legrand North America, LLC.
- C. Finish: Manufacturer's standard enamel finish in color selected by Architect.
- D. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- E. Comply with TIA-569-D.

2.06 BOXES, ENCLOSURES, AND CABINETS

- A. Description: Enclosures for communications.
- B. General Requirements for Boxes, Enclosures, and Cabinets:
 - 1. Comply with TIA-569-D.
 - 2. Boxes, enclosures, and cabinets installed in wet locations shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for use in wet locations.
 - 3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
 - 4. Device Box Dimensions: Refer to Telecommunications Configuration Schedule on drawings.
 - 5. Gangable boxes are prohibited.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.
- E. Metal and non-metallic Floor Boxes:
 - 1. Refer to Division 26 specifications for floor boxes and poke thru boxes.
- F. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1in dry locations and Type 3R in wet locations, 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:
 - a. Material: Plastic or Fiberglass.
 - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- G. Cabinets:
 - 1. NEMA 250, Type 1 in dry locations and Type 3R in wet locations, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.

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6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.07 POLYMER CONCRETE HANDHOLES

- A. Description: Molded of sand and aggregate; bound together with polymer resin; and reinforced with steel, fiberglass, or a combination of the two.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Armorcast Products Company.
 - 2. Oldcastle Infrastructure Inc.; CRH Americas.
 - 3. Quazite; Hubbell Incorporated, Power Systems.
- C. General Requirements for Polymer Concrete Handholes:
 - 1. Boxes and handholes for use in underground systems shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 - 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 - 3. Comply with TIA-569-D and SCTE 77.
- D. Configuration: Designed for flush burial with integral closed bottom unless otherwise indicated.
- E. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 - 1. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 2. Cover Legend: Molded lettering, "COMMUNICATIONS".
- F. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
- G. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.08 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 - 1. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 - 2. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 EXECUTION

3.01 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
 - 1. Exposed Conduit: GRC.
 - 2. Concealed Conduit, Aboveground: GRC.
 - 3. Underground Conduit:
 - a. Ductbank: Type EPC-40-PVC.
 - b. Ductbank under traffic pattern: EPC-40-PVC concrete encased.
 - c. Under building to a minimum of 5 feet beyond foundation wall: GRC
 - 4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R or Type 4 as applicable to use.
- B. Indoors: Apply pathway products as specified below unless otherwise indicated:
 - 1. Exposed, Not Subject to Physical Damage: EMT.
 - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 - 3. Exposed and Subject to Severe Physical Damage: GRC.
 - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 - 5. Damp or Wet Locations: GRC.

- 6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway Plenum-type, communications-cable pathway or EMT.
- 7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: Risertype, optical-fiber-cable pathway Riser-type, communications-cable pathway or EMT.
- 8. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: EMT.
- 9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless-steel units in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Pathway Size: 1-inch trade size for CAT6 copper cables, and 1-1/4 inch for CAT6A copper cables or optical-fiber cables unless specified otherwise in the Telecommunications Outlet Configuration Schedule on the drawings.
- D. Pathway Fittings: Compatible with pathways 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:
 - a. Dry Locations: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
 - b. Wet Locations: Use compression type fittings
 - 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. Install surface pathways only where indicated on Drawings or previously approved.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.02 INSTALLATION

- A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:
 - 1. NECA 1.
 - 2. ANSI/BICSI N1-2019 .
 - 3. TIA-569-D.
 - 4. NECA 101
 - 5. NECA 105.
- B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- C. Comply with requirements in Section 27 05 29 Hangers and Supports for Communications Systems for hangers and supports.
- D. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- E. Complete pathway installation before starting conductor installation.
- F. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- G. Install no more than the equivalent of two 90-degree bends within any 100-foot pathway run and no pathway run shall exceed 100 feet without a pull location. Support within 12 inches of changes in direction.
- H. Utilize long radius ells for all optical-fiber and copper cables per BICSI TDMM.
- I. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to walls, structural members, or intersections of vertical

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planes to maintain headroom and provide neat appearance. Follow surface contours as much as possible.

- J. Conduits shall be supported at a maximum of seven-foot intervals and within 12 inches of enclosures to which attached.
- K. Pathways 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 pathways to reinforcement at maximum 10-foot intervals.
 - 2. Arrange pathways to cross building expansion joints at right angles with expansion fittings. Comply with requirements for expansion joints specified in this article.
 - 3. Arrange pathways to keep a minimum of 2 inches 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 nonmetallic conduit and fittings to GRC or IMC and fittings before rising above floor.
- L. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for pathways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- M. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- N. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
- O. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure, to assure a continuous ground path.
- Q. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- R. Install pull wires in empty pathways. 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. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.
- S. Surface Pathways:
 - 1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
 - 2. Install surface pathway with a minimum 2-inch radius control at bend points.
 - 3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- T. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
 - 1. 1-1/4 Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet.
 - 2. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- U. Install pathway-sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a
blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathwaysealing fittings according to NFPA 70.

- V. Install devices to seal pathway 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 pathways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service pathway enters a building or structure.
 - 3. Where otherwise required by NFPA 70.
- W. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
 - Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT that is located where environmental temperature change may exceed 100 deg F, and that has straight-run length that exceeds 100 feet.
 - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
 - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 - 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 - 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
 - . Mount boxes at heights indicated on Drawings and details. 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. In all instances, coordinate final box height with architect prior to rough-in.
- Z. Outlet boxes shall not be installed back-to-back in walls. Provide minimum 6-inch separation in non-acoustic-rated walls and 24-inch separation in acoustic-rated walls. Install in separate stud cavity for fire rated walls.
- AA. Coordinate mounting heights and locations of boxes mounted above counters, benches, and backsplashes.
- BB. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box. Use boxes with sufficient depth to permit conduit hubs to be located in masonry void spaces.
- CC. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.
- DD. 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.
- EE. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

- FF. Set metal floor boxes level and flush with finished floor surface.
- GG. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.03 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 Division 31 for pipe of less than 6 inches in nominal diameter.
 - 2. Install backfill as specified in Division 31.
 - 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 Division 31.
 - 4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
 - 5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete around conduit for a minimum of 12 inches on each side of the coupling.
 - b. 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.
 - 6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits, but a minimum of 6 inches below grade. Align planks along centerline of conduit.

3.04 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. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.
- F. Field cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.05 SLEEVE AND SLEEVE SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves and sleeve seals or rated cable pathways at penetrations of exterior floor and wall assemblies.

3.06 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Division 07. Contractor shall use a UL listed firestop system listed for the use that restores the penetrated construction to its original fire and smoke rating.

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3.07 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage or 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

SECTION 27 0529

HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 SCOPE

- A. This section includes product and execution requirements for items unique to communications systems and not included in Division 26 sections.
- B. Refer to Section 27 05 00 General Communications Requirements.

1.02 RELATED WORK

- A. Related Division 27 Sections include:
 - 1. Section 27 05 00 General Communications Requirements
 - 2. Section 27 05 28 Pathways for Communications Systems
 - 3. Section 27 05 33 Raceway and Boxes for Communications Systems
 - 4. Section 27 05 36 Cable Tray for Communications Systems
- B. Related sections in other Divisions of Work:
 - 1. Section 26 05 48 Seismic Controls for Electrical Systems

1.03 REFERENCES AND STANDARDS

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Slotted support systems, hardware, and accessories.
 - b. Clamps.
 - c. Hangers.
 - d. Sockets.
 - e. Eye nuts.
 - f. Fasteners.
 - g. Anchors.
 - h. Saddles.
 - i. Brackets.
 - 2. Include rated capacities and furnished specialties and accessories.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 to design hanger and support system.
- B. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified."
 - 2. Component Importance Factor: 1.5.

2.02 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inchdiameter holes at a maximum of 8 inches o.c. in at least one surface.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Flex-Strut Inc.
 - b. G-Strut.

- c. Unistrut; Atkore International.
- 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.
- 6. Channel Dimensions: Selected for applicable load criteria.
- B. Conduit and Cable Support Devices: Steel clamps, hangers, 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 communications 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.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Hilti, Inc.
 - 2) MKT Fastening, LLC.
 - 3) Simpson Strong-Tie Co., Inc.
 - 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.
 - 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) B-line; Eaton, Electrical Sector.
 - 2) Hilti, Inc.
 - 3) MKT Fastening, LLC.
 - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
 - 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
 - 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 6. Toggle Bolts: All-steel springhead type.
 - 7. Hanger Rods: Threaded steel.

2.03 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 for steel shapes and plates.

2.04 TYPE CABLE SUPPORT HOOKS

- A. Cable support hooks shall be a wide-base type for use in a non-continuous pathway.
- B. Hook material shall be Galvanized metal or Nylon for smooth cable pull and corrosion resistance.
 - 1. Hook may be coated to reduce cable friction.
 - 2. Hook material shall be rigid. Flexible material not allowed.

- C. Hooks shall:
 - 1. Comply with UL, cUL, NEC and TIA requirements for structured cabling systems.
 - 2. Be designed to limit cable bending per cable manufacturers' recommendations.
 - 3. Be capable of being installed in a single- or multiple-hook ("tree") configuration.
 - 4. Incorporate a latch or other mechanism to retain cable.

PART 3 EXECUTION

3.01 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. ANSI/BICSI N1-2019.
 - 3. TIA-569-D.
 - 4. NECA 101
 - 5. NECA 105.
- B. Comply with requirements in Division 07 for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for pathways specified in Section 27 05 28 Pathways for Communications Systems.
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in 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 or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.

3.02 SUPPORT INSTALLATION

- A. 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.
- B. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten communications 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: Use approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Use 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 by means that comply with seismic-restraint strength and anchorage requirements.
- C. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor communications materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 TYPE CABLE SUPPORT HOOKS

- A. Where installed free-air above suspended ceiling or below raised floor, support cables using Jhook type cable supports installed in accordance with manufacturer's installation requirements.
- B. Support hooks from structure. Do not support from ceiling grid, conduit or other trades work.
- C. Space J-hook cable supports every 4 ft or in accordance with cable manufacturer's specifications, whichever distance is shorter.
- D. J-hook fill capacities shall be per manufacturer's recommendations and shall consider diameter of cable type(s) being installed.

3.05 PAINTING

- A. Touchup: Comply with requirements in Division 09, "09 9000 Painting and Coating" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 27 0533

RACEWAY AND BOXES FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 SCOPE

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. This section includes product and execution requirements for items unique to communications and not included in Division 26 sections.
- C. Refer to Section 27 05 00 General Communications Requirements.

1.02 RELATED WORK

- A. Related Division 27 Sections include:
 - 1. Section 27 05 00 General Communications Requirements
 - 2. Section 27 05 28 Pathways for Communications Systems
 - 3. Section 27 05 29 Hangers and Supports for Communications Systems
 - 4. Section 27 05 36 Cable Tray for Communications Systems
- B. Related sections in other Divisions of Work:
 - 1. Section 26 05 48 Seismic Controls for Electrical Systems

1.03 REFERENCES AND STANDARDS

- A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.
- B. Work under this Section is subject to the references and standards requirements of Section 27 05 00 General Communications Requirements.

1.04 ACTION SUBMITTALS

- A. Product data for the following:
 - 1. Outlet Boxes
 - 2. Pull and Junction Boxes
 - 3. Raceways and Wireways (including sleeves, expansion fittings, penetrations and seals)
 - 4. Poke-through Fittings
 - 5. Floor Boxes
 - 6. Cable Supports
 - 7. Underground handholes and boxes.

PART 2 PRODUCTS

2.01 COMMUNICATIONS RACEWAYS

- A. OPTICAL FIBER/COMMUNICATIONS CABLE RACEWA (INNERDUCT)
 - 1. UL 2024; flexible type, approved for riser installation.
 - 2. Outdoor Innerduct: Smooth outside and ribbed inside.
 - 3. Indoor Innerduct: Corrugated.
 - 4. Color: Orange
 - 5. Manufacturers: Carlon, Pyramid, or approved equal.

2.02 MULTI CELL FLEXIBLE RACEWAY

- A. Manufacturers: MaxCell™.
- B. Multi-cell flexible raceway shall be a flexible, multi-celled, textile innerduct system designed for communications.
- C. Multi-cell flexible raceway shall meet the following physical requirements:
 - 1. UL 2024; flexible type, approved for riser (OFCR FT-4) installation
 - 2. Tensile strength: 2500 lbs or better
 - 3. Melting Point: 480°F or better
 - 4. Resistant to ground chemicals and petroleum products

- 5. Unaffected by mud, silt or debris after placement of cable.
- D. Shall be pre-lubricated for lower friction during flexible raceway and cable installation.
- E. Multi-cell flexible raceway color shall be white.
 - 1. Multi-cell flexible raceway shall include a color-coded stripe allowing for identification of each bundle.
- F. Each cell shall include a color-coded pull tape.
- G. Product shall be available in a variety of sizes and cell counts. Refer to project Drawings.

PART 3 EXECUTION

3.01 COMMUNICATIONS RACEWAYS

- A. Optical Fiber Communications Cable Raceway (Innerduct):
 - 1. Minimum innerduct size: 1" unless otherwise noted on drawings.
 - 2. Extend innerduct to termination and/or storage enclosure.
 - 3. Provide couplings designed for innerduct size and type where innerduct enters a termination and/or storage enclosure.
 - 4. Splice innerduct segments using couplings designed for that purpose, where not installed in a continuous length.
 - 5. Provide 200 lb. nylon pull cord in all empty innerduct. Leave at least 12" of slack at each end of pull wire. Cap innerduct at both ends.
 - 6. Label innerduct with tags indicating cable type and cables contained therein.
 - a. Label in each maintenance hole, pull box and communications equipment room, where exiting a conduit and at 10 foot intervals in cable tray or where otherwise exposed.

3.02 MULTI CELL FLEXIBLE RACEWAY

- A. Segment conduits to increase capacity.
 - 1. Provide quantity and size per project Drawings.
- B. Install per manufacturers recommendations.

END OF SECTION

SECTION 27 0536

CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 SCOPE

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. This section includes product and execution requirements for items unique to communications and not included in Division 26 sections.
- C. Refer to Section 27 05 00 General Communications Requirements.
- D. Communications Cable tray system shall carry:
 - 1. voice and data cable
 - 2. Video Surveillance (Ethernet cables only)
 - 3. Building Automation System (Ethernet cables only)

1.02 RELATED WORK

- A. Related Division 27 Sections include:
 - 1. Section 27 0500 General Communications Requirements
 - 2. Section 27 0526 Grounding and Bonding for Communications Systems
 - 3. Section 27 0528 Pathways for Communications Systems
 - 4. Section 27 0529 Hangers and Supports for Communications Systems
- B. Related sections in other Divisions of Work:
 - 1. Section 26 05 48 Seismic Controls for Electrical Systems

1.03 REFERENCES AND STANDARDS

- A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.
- B. Work under this Section is subject to the references and standards requirements of Section 27 0500 General Communications Requirements.
- C. Additional Standards:
 - 1. ASTM A 123 Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and forged Steel Shapes, Plates, Bars, and Strip.
 - 2. ASTM A 446 Specification for Zinc-Coated (Galvanized) by Hot-Dip Process, Structural (Physical) Quality.
 - 3. ASTM A 525 Specification for Steel Sheet, Zinc-Coated Galvanized by Hot Dip Process.
 - 4. ASTM A 607 Specification for Steel Sheet and Strip, Hot-rolled and Cold-Rolled, High Strength, Low Alloy Columbium or Vanadium.
 - 5. ASTM B 633 Specification for Electro-deposited Coatings of Zinc on Iron and Steel.
 - 6. ASTM A653/A653M-22 Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - 7. ASTM A1011/A1011M-18A Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
 - 8. ASTM A1008/A1008M-21a Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable.
 - 9. ASTM A510/A510M-08 Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
 - 10. ASTM F1136/F1136M-11 Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners
 - 11. ASTM F593-17 Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
 - 12. ASTM F594-09 Specification for Stainless Steel Nuts
 - 13. ASTM D769-01 Specification for Black Synthetic Iron Oxide

- 14. NEMA VE 1 Metal Cable Tray Systems
- 15. NEMA VE 2 Cable Tray Installation Guidelines
- 16. BICSI Telecommunications Distribution Methods Manual (TDMM)

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of cable tray.
 - 1. Include data indicating dimensions and finishes for each type of cable tray indicated.
- B. Shop Drawings: For each type of cable tray.
 - 1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.
 - 2. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - a. Vertical and horizontal offsets and transitions.
 - b. Clearances for access above and to sides of cable trays.
 - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
 - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

1.05 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Data: Certificates, for cable trays, 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. 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.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Cable trays and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the cable trays will remain in place without separation of any parts when subjected to the seismic forces specified."
 - 2. Component Importance Factor: 1.5

2.02 GENERAL REQUIREMENTS FOR CABLE TRAYS

- A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
 - 1. Source Limitations: Obtain cable trays and components from single manufacturer.
 - 2. Interconnected components shall be UL listed or classified for suitability for use as an equipment grounding conductor.
- B. Structural Performance: See articles for individual cable tray types for specific values for the following parameters:
 - 1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
 - 2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
 - 3. Load and Safety Factors: Applicable to both side rails and rung capacities.

2.03 CABLE RUNWAY aka LADDER CABLE TRAY

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

- 1. Chatsworth Products, Inc.
- 2. Cooper B-line; brand of Eaton, Electrical Sector.
- 3. MP Husky USA Cable Tray & Cable Bus.
- B. Description:
 - 1. Configuration: Two longitudinal side rails with transverse rungs swaged or welded to side rails, complying with NEMA VE 1.
 - 2. Width: as indicated on Drawings.
 - a. Basis of design: Chatsworth CPI 10250-xxx series
 - 3. Minimum Usable Load Depth: 2inches.
 - a. Provide Cable Retaining Posts for fill depths exceeding 4" as follows:
 - 1) 6" fill depth: 10596-706
 - 2) 8" fill depth: 10596-708
 - 4. Straight Section Lengths: 10 feet, except where shorter lengths are required to facilitate tray assembly.
 - 5. Rung Spacing: 9 inches o.c.
 - 6. Radius-Fitting Rung Spacing: 9 inches at center of tray's width.
 - 7. Minimum Cable-Bearing Surface for Rungs: 7/8-inch width with radius edges.
 - 8. No portion of the rungs shall protrude below the bottom plane of side rails.
 - 9. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lbconcentrated load, when tested according to NEMA VE 1.
 - 10. Cable Runway Radius Dropouts shall maintain minimum cable bend radius of 3"
 - a. BOD Cross Member: CPI 12100-xxx series
 - b. BOD String Runway: CPI 12101-xxx series
 - 11. Fitting Minimum Radius: 12 inches.
 - 12. Comply with NEMA VE 1, support spacing maximum of 8 feet on center or per manufacturers recommendations, whichever is less.
 - 13. Provide one support within 2 feet of connection to each cable tray fitting.
 - 14. Splicing Assemblies: Bolted type using serrated flange locknuts.
 - 15. Splice-Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
 - 16. Provide all mounting hardware, splices, grounding kits, and support brackets to form a complete, code compliant, and structurally compliant cable runway system.
- C. Materials and Finishes:
 - 1. Steel:
 - a. Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of either "ASTM A1011/A1011M, SS, Grade 33" or "ASTM A1008/A1008M, Grade 33, Type 2".
 - b. Steel Tray Splice Plates: ASTM A1011/A1011M, HSLAS, Grade 50, Class 1.
 - c. Fasteners: Steel complies with the minimum mechanical properties of ASTM A510/A510M, Grade 1008.
 - d. Finish: Powder-coat enamel paint.
 - 1) Powder-Coat Enamel: Cable tray manufacturer's recommended primer and corrosion-inhibiting treatment, with factory-applied powder-coat paint.
 - 2) Epoxy-Resin Prime Coat: Cold-curing epoxy primer, MPI# 101.
 - 3) Epoxy-Resin Topcoat: Epoxy, cold-cured gloss, MPI# 77.
 - 4) Hardware: Chromium-zinc plated, ASTM F1136.

2.04 WIRE MESH CABLE TRAY

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cablofil; Legrand North America, LLC.
 - 2. Chalfant Manufacturing Company.
 - 3. Cooper B-line; brand of Eaton, Electrical Sector.
 - 4. Eaton.

- 5. FlexTray; Eaton.
- 6. GS Metals.
- 7. MP Husky USA Cable Tray & Cable Bus.
- B. Description:
 - 1. Configuration: steel wire mesh, complying with NEMA VE 1.
 - 2. Width: indicated on Drawings.
 - 3. Minimum Usable Load Depth: 2 inches unless indicated otherwise on plans.
 - 4. Straight Section Lengths: 10 feet, except where shorter lengths are required to facilitate tray assembly.
 - 5. Structural Performance: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb concentrated load, when tested according to NEMA VE 1.
 - 6. Comply with NEMA VE 1, maximum support spacing 5 feet on center or per manufacturers recommendations, whichever is less.
 - a. Total vertical tray deflection shall not exceed 1-1/2" between supports when tray is loaded to capacity.
 - b. Maximum allowable deviation of tray, from level horizontal plane measured across width of tray, is one half of one inch (1/2") with tray loaded to capacity.
 - 1) Approval of installation method does not relieve contractor from meeting above deviation requirement. If additional support is needed, as determined by project engineer, contractor shall provide additional support at no additional cost.
 - 7. Provide one support within 2 feet of connection to each cable tray fitting.
 - 8. Splicing Assemblies: Bolted type using serrated flange locknuts.
 - 9. Splice-Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
- C. Materials and Finishes:
 - 1. Steel:
 - a. Straight Sections and Fittings: Steel complies with the minimum mechanical properties of either "ASTM A1011/A1011M, SS, Grade 33" or ASTM A1008/A1008M, Grade 33, Type 2".
 - b. Steel Tray Splice Plates: ASTM A1011/A1011M, HSLAS, Grade 50, Class 1.
 - c. Fasteners: Steel complies with the minimum mechanical properties of ASTM A510/A510M, Grade 1008.
 - 2. Finish:
 - a. Finish: Electro Zinc
 - b. Hardware: Chromium-zinc plated, ASTM F1136.

2.05 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
- B. Barrier Strips: Same materials and finishes as for cable tray.
- C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.06 WARNING SIGNS

- A. Comply with requirements for identification in Section 270553 "Identification for Communications Systems."
- B. Lettering: 1-1/2-inch high, black letters on yellow background with legend "Warning Not To Be Used as Walkway, Ladder, or Support for Ladders or Personnel."

2.07 SOURCE QUALITY CONTROL

A. Testing: Test and inspect cable trays according to NEMA VE 1.

PART 3 EXECUTION

3.01 CABLE TRAY INSTALLATION

- A. Install cable trays according to NEMA VE 2.
- B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.
- C. Cable tray shall not be installed directly on floor. Provide structural channel or other mounting hardware to provide a gap between bottom of cable tray and floor. Coordinate size of gap with surface conduit sizes or piping crossing under cable tray.
- D. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.
- E. Maintain minimum clearances and accessibility with other cable tray components and equipment/materials of all other trades as follows:
 - 1. Bottom of tray to:
 - a. ceiling panels: 2"
 - 1) Tray shall not restrict removal of ceiling panels or lighting assemblies. Additional clearance may be required for light fixtures.
 - 2. Any part of tray to heat sources: minimum of 12"
 - 3. Along one side of tray: 18"
 - a. Clearance can alternate to each side of tray along route if required by obstructive conditions.
 - b. Obstructions on both sides of tray route shall not exceed 6 continuous feet.
 - 4. Above cable tray: 12"
 - 5. Do not install cable tray below re-heat coils, VAV boxes, traps, or other building components that require access from below.
 - 6. Refer to specification section 27 1000 Structured Cabling for separation requirements from potential EMI sources.
 - 7. Notify Engineer for clarification and direction before proceeding with installation if access conditions cannot be met.
- F. All trays shall be cut using the Cablofil tray cutter: COUPFIL or CUT FIL.
 - 1. All cut cable tray shall be filed to remove burrs.
- G. Cable Runway Retaining post installation shall not exceed 18" maximum spacing.
- H. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lb. Comply with requirements in Section 270529 "Hangers and Supports for Communications Systems. Comply with seismic-restraint details according to Section 260548 "Seismic Controls for Communications Systems.
- I. Support bus assembly to prevent twisting from eccentric loading.
- J. Locate and install supports according to NEMA VE 2, manufacturer recommendations, governing codes and standards, and owner standards and specifications. When conflicting requirements occur, the most stringent requirements shall govern. Do not install more than one cable tray splice between supports. Support spacing shall not exceed 8'-0" on center under any circumstances.
- K. Support cable tray system utilizing trapeze hangers from building or other structural steel members, angle brackets from vertical structural steel members, upright angle brackets on pipe racks, or directly upon horizontal structural steel members of the building or pipe racks.
 - 1. Center-hung supports, central hanger supports, hanger rod clamps, single/double channel tray hangers, single rail cable tray hangers, shall not be allowed.
 - 2. Cable tray may be wall mounted only in cases where trapeze mounting from above is not possible due to obstructions. Contractor shall review such situations with Engineer for approval prior to installation.
 - 3. Support trapeze hangers for cable trays with 3/8-inch diameter rods.

- 4. Supports shall be constructed from formed shape channel members 1.625" x 1.625", pregalvanized 14 Ga. steel complete with nuts, bolts, washers, lock washers and tray clamps as required for complete and finished installation.
 - a. Where formed mounting assemblies are part of manufacturer's integrated cable tray system, these may be used in compliance with manufacturers recommended practices.
- L. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.
- M. Make changes in direction and elevation using manufacturer's recommended fittings.
- N. Make cable tray connections using manufacturer's recommended fittings.
- O. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 078413 "Penetration Firestopping."
 - 1. Where cable tray would penetrate a wall, stop tray at wall and fasten tray end to wall.
 - 2. Provide quantity of re-enterable, self-sealing, fire rated cable pathway devices UL listed for the purpose with cross sectional area equivalent to cable tray.
 - a. Each cable pathway device shall maintain maximum of 40% cable fill ratio.
 - b. Provide plastic bushings on both ends of each sleeve.
 - c. Cable pathway devices shall extend beyond both sides of fire rated wall as required to meet UL fire rated assembly requirements. Final assembly shall carry UL listing to restore fire and smoke rating of wall being penetrated.
- P. Where cable tray distribution system encounters inaccessible ceiling area, provide sufficient 4" EMT sleeves/conduit through area to maintain same available cross-sectional area as cable tray.
 - 1. Each sleeve/conduit shall maintain maximum of 40% cable fill ratio.
- Q. Install cable trays with enough workspace to permit access for installing cables.
- R. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.02 CABLE TRAY GROUNDING

- A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems."
- B. Cable trays shall be bonded together with UL listed bonding jumpers and be electrically continuous.
- C. Cable trays with single-conductor power conductors shall be bonded together with a grounding conductor run in the tray along with the power conductors and bonded to the tray at 72-inchintervals. The grounding conductor shall be sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors," and Article 392, "Cable Trays."
- D. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.
- E. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."
- F. Cable tray segments becoming electrically non-continuous where passing through walls or other construction shall be bonded together on both sides thru the opening to restore the grounding path using a UL listed bonding jumper.
 - 1. When Telecommunications grounding system conductors are routed in the tray and pass thru conductive sleeves or re-enterable cable pathway devices, the cable tray shall be bonded to the sleeves and cable pathway devices using UL listed bonding jumpers.
- G. Connect each cable tray system subassembly to building ground system using grounding clamps and grounding conductors. Provide 3.0 ohm maximum resistance to building ground connection.

- H. Cable tray shall not be connected to instrumentation grounding system.
- I. Bond conduits to cable tray as defined by NEC references in NEMA VE-1 and VE-2.

3.03 CABLE INSTALLATION

- A. Install cables only when each cable tray run has been completed and inspected.
- B. Cable tray loading shall never exceed 50% of the cross-sectional area of tray segment per OESC 392.9 (A) 1 after reserved future capacity has been used. Maintain 50% future capacity after project completion available to owner upon building turnover.
- C. Fasten cables on vertical runs to cable trays as required by applicable standards and cable manufacturers recommendations.
- D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches.
- E. Tie MI cables down every 36 inches where required to provide a 2-hour fire rating and every 72 inches elsewhere.

3.04 CONNECTIONS

- A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.
- B. Connect pathways to cable trays according to requirements in NEMA VE 2.

3.05 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
 - 2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
 - 3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
 - 4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
 - 5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
 - 6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
 - 7. Check for improperly sized or installed bonding jumpers.
 - 8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
 - 9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.
- B. Prepare test and inspection reports.

3.06 PROTECTION

- A. Protect installed cable trays and cables.
 - 1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.

- 2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
- 3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION

SECTION 27 1000

STRUCTURED CABLING

PART 1 GENERAL

1.01 SCOPE

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. This section details product and execution requirements for Structured Cabling for Communications Systems.

1.02 DESCRIPTION

- A. Systems shall include cabling, termination hardware and active components, installed as indicated on drawings and specifications.
- B. Cables and equipment shall be provided, tested, and terminated, including proper grounding and bonding.

1.03 RELATED WORK

- A. Refer to Section 27 0500 General Communications Requirements which identifies pertinent related specifications.
- B. Related sections in other Divisions of Work:
 - 1. Refer to individual technical sections identified above (if applicable).

1.04 REFERENCES AND STANDARDS

- A. Refer to Section 27 0500 General Communications Requirements which identifies pertinent References and Standards.
- B. In addition:
 - 1. TIA 568.0-D through.4-D Commercial Building Telecommunications Cabling Standard (including applicable Addenda)
 - 2. TIA 569-E Commercial Building Standard for Telecommunications Pathways and Spaces.
 - 3. BICSI Telecommunications Distribution Methods Manual (TDMM), 14th Edition
 - 4. TIA-758-B Customer-Owned Outside Plant Telecommunications Infrastructure Standard
 - 5. TIA-862-B Structured Cabling Infrastructure Standard for Intelligent Building Systems
 - 6. TIA-598-D: Optical Fiber Cable Color Coding.
 - 7. TIA 455-21-A: Mating Durability for Fiber Optic Interconnecting Devices
 - 8. TIA 526-14-C: Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
 - 9. TIA-526-7-A: Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
 - 10. IEEE 802.3af and 802.3at Power-over-Ethernet Standards.
 - 11. IEEE 802.3an 10 Gigabit Standard

1.05 DEFINITIONS

- A. Refer to Section 27 0500 General Communications Requirements for general terminology used in Division 27 sections.
- B. In addition, the following definitions are applicable to communications environments and shall apply to this document and its companion sections for clarification and direction:
 - 1. Backbone Cabling cable or conductors between telecommunications rooms, or floor distribution terminals, entrance facilities, and equipment rooms within or between buildings. Backbone cabling may be twisted pair copper, fiber optic or coaxial.
 - 2. Cable assembly of 1 or more conductors or optical fibers within enveloping sheath, constructed so as to permit use of conductors singly or in groups.
 - 3. Cable ID unique alpha-numeric identification used for tagging of backbone or horizontal cabling.

- 4. Channel end-to-end transmission path to which application-specific equipment is connected. Same as "Permanent Link", but also includes patch cords at Telecommunications Outlet and in Telecom Room.
- 5. Consolidation Point (CP): A location for interconnection between horizontal cables extending from the horizontal cross-connect and horizontal cables extending to the telecommunication outlet at the workstation.
- 6. Contractor: Telecommunications Contractor or sub-contractor(s) responsible for installation, termination, test and documentation of communications cabling, termination components, pathway hardware, telecommunications equipment room hardware and related components detailed in technical sections of this Division of work.
- 7. Cross-Connect group of connection points between cabling runs and/or equipment used to administer building wiring using patch cords or wire jumpers.
- 8. Horizontal Cabling Cables connecting Telecommunications Outlets to horizontal or intermediate cross-connect. Sometimes referred to as "Station Cabling".
- 9. Horizontal Cross-connect (HC) Connection of horizontal cabling to other cabling (e.g. horizontal, backbone or equipment) using patch cords or wire jumpers.
- 10. Interconnection Connection scheme using connecting hardware for the direct connection of a cable to another cable without a patch cord or jumper
- 11. Main Cross-connect (MC) Connection between backbone cables, entrance cables and equipment cables using patch cords or wire jumpers.
- 12. Outlet ID unique alpha-numeric identification used for referencing Telecommunications Outlet or connectors therein.
- 13. Permanent (Cable) Link includes Telecommunications Outlet, horizontal (station) cable and termination hardware in Telecom Room.
- 14. Service Loop Surplus cable, typically located at or near point of termination to enable future changes.
- 15. Telecommunications Outlet (TO) device assembly located in work area on which horizontal cabling terminates and which can receive modular connectors. It is interface between Station Cable and end user's equipment.
- 16. Telecom Room an enclosed space for housing telecommunications equipment, horizontal and backbone cable terminations, and cross-connect cabling, that is recognized location of horizontal cross-connect.
- 17. Zone Box An enclosure used to house one or more of the following: a) a consolidation point, b) a horizontal connection point, c) building automation system outlets.
- 18. Zone Cabling Extends permanent horizontal cabling to a shared termination (consolidation) point in the work area. Passive system extends link to workstation through at interconnect at the Consolidation Point (CP). Active system includes system electronics at the CP.
- C. "10-gigabit" or "10G" performance criteria, if applicable, refers to support of 10GBASE-T application over 4-connector channel up to 100 meters and meeting requirements of TIA-568-C.2.

1.06 ABBREVIATIONS AND ACRONYMS

- A. Refer to Section 27 0500 General Communications Requirements for general terminology used in Division 27 sections.
- B. In addition, the following abbreviations and acronyms shall apply to this document and its companion sections for clarification and direction:
 - 1. 8P8C: Eight-Position, Eight-Conductor. Used in clarifying jack type; a.k.a. "RJ-45".
 - 2. CM: Communications cable rated for General Purpose use
 - 3. CMP: Communications cable rated for use in Plenum areas
 - 4. CMR: Communications cable rated for use in Risers and vertical runs
 - 5. CP: Consolidation Point
 - 6. DTE: Data Terminal Equipment
 - 7. ELFE T: Equal-Level Far-End Cross Talk (pair-to-pair)
 - 8. FE T: Far-End Cross Talk

- 9. F/UTP: Foiled Unshielded Twisted Pair
- 10. No shielding around individual pairs and an overall foil shield under the cable jacket
- 11. HC: Horizontal Cross-connect
- 12. HCP: Horizontal Connection Point (e.g., for TIA-862)
- 13. IDF: Intermediate Distribution Frame
- 14. MC: Main Cross-connect
- 15. MDF: Main Distribution Frame
- 16. MDI: Medium Dependent Interface
- 17. MPTL: Modular Plug Terminated Link
- 18. N: Newton
- 19. NE T: Near End Cross Talk
- 20. OFNP: Optical Fiber Nonconductive Plenum
- 21. OFNR: Optical Fiber Nonconductive Riser
- 22. OTDR: Optical Time Domain Reflectometer
- 23. PB : Private Branch Exchange (Telephone Switch)
- 24. PoE: Power-over-Ethernet
- 25. PSNE T: Power Sum Near End Cross Talk
- 26. S/FTP: Screened Foiled Twisted Pair
 - a. (Individual foil shield around each individual pair and an overall braided shield under the cable jacket.)
- 27. S/UTP: Screened Unshielded Twisted Pair
 - a. (No shielding around individual pairs and an overall braided shield under the cable jacket.)
- 28. SF/UTP: Screened Foiled Unshielded Twisted Pair
 - a. (No shielding around individual pairs and overall foil and braided shields under the cable jacket.)
- 29. TO: Telecommunications Outlet
- 30. TR: Telecommunications Room
- 31. USOC: Universal Service Order Code
- 32. UTP: Unshielded Twisted Pair
 - a. (No shielding around pairs nor overall under cable jacket.)
- 33. U/FTP: Unshielded Foiled Twisted Pair
- 34. (Individual foil shield around each individual pair and no overall braided shield under the cable jacket.)

1.07 DIVISION OF WORK BETWEEN OWNER AND CONTRACTORS

A. Refer to Section 27 0500 - General Communications Requirements which identifies Work by Owner affecting sub-system(s) covered by this section.

1.08 SUBMITTALS

- A. Refer to Section 27 0500 General Communications Requirements which provides general guidelines for product or installation information to be submitted by Contractor.
- B. In addition, Submit:
 - 1. Contractor Certification documents which document their participation in Installers Program operated by Manufacturer of Cabling or Termination Components used.
 - a. Upon request, Certified Installer(s) assigned to Project shall be identified to Engineer.
 - Meeting agenda for Pre-Construction Coordination Meeting

1.09 QUALITY ASSURANCE

A. General:

2.

- 1. Cable and Equipment Manufacturer(s) shall be company specializing in communications cable, accessories and/or equipment with minimum of 5 years documented experience in producing cable, accessories and/or equipment similar to those specified herein.
- B. Contractor Qualifications:
 - 1. Qualified personnel utilizing state-of-the-art equipment and techniques shall complete cable and equipment installation and termination.

- 2. Contractor shall have been in this business for minimum of 5 years and shall have successfully completed 4 projects equal in magnitude of system specified in the following sections.
- C. Contractor shall have necessary certifications to provide for Warranty as specified herein.
 - 1. Contractor shall be an active participant in Installers Program operated by Manufacturer of Cabling or Termination Components used.
 - a. Contractor shall be participant in this program at time of Bidding and remain so throughout project.

1.10 GUARANTEE

- A. Refer to Division 01, General Conditions, and General Requirements Guarantee Documents and Section 27 05 00 - General Communications Requirements for general guarantee requirements.
- B. Warranty structured cable system as follows:
 - 1. 4-pair Category-rated Horizontal Copper Permanent Link for no-less than 20 years from date of substantial completion of work.
 - 2. Copper Backbone for no-less than 2 years from date of substantial completion of work. Cabling and Connecting Components shall carry 20 yr component warranty.
 - 3. Fiber Optic Backbone for no-less than 20 years from date of substantial completion of work.
- C. Warranty shall be direct from manufacturer(s) of cabling and connecting components to Owner.

PART 2 PRODUCTS

2.01 GENERAL

A. Refer to individual Technical Sections.

2.02 POWER OVER ETHERNET

- A. All cable and connecting components that comprise the TIA horizontal cabling "Permanent Link" from Horizontal Cross-connect to Telecommunications Outlet shall be compliant with the applicable requirements for "DTE Power via the MDI" to provide at least 51W at the Powered Device as defined by the IEEE 802.3bt standard.
- B. Connecting hardware shall comply with IEC 60512-99-002 for engaging and separating connectors under electrical load and connectors used in twisted pair communication cabling with remote power.

2.03 SYSTEM REQUIREMENTS

- A. Structured cabling products shall be designed to work together as a fully warranted system.
- B. Acceptable Category 6 systems shall be:
 - 1. Belden REVConnect 2400
 - 2. CommScope S STIMA GigaSPEED L
 - 3. Hubbell Premise Wiring NE TSPEED 6
 - 4. Leviton C 6200 Cat 6 Premium UTP System
 - 5. Panduit Enhanced Category 6 System (Panduit cable only)
 - 6. Siemon Premium 6 Z-MÅ
- C. Acceptable Category 6A systems shall be:
 - 1. Belden REVConnect 10G 12
 - 2. CommScope S STIMA GigaSPEED 10D
 - 3. Hubbell Premise Wiring NE TSPEED 6A
 - 4. Leviton C 6700 Cat 6A Enhanced UTP System
 - 5. Panduit Category 6A MaTri system (Panduit cable only)
 - 6. Siemon Z-MA 6A

PART 3 EXECUTION

3.01 PRE CONSTRUCTION COORDINATION MEETING

- A. Prior to preparing and submitting submittals, Contractor shall arrange and conduct a preconstruction coordination meeting to review and coordinate Structured Cabling requirements.
 - 1. Attendees shall include:
 - a. Owner's project manager and Information Technology / Information Services representative(s)
 - b. Division 27 Engineer
 - c. Construction Manager / General Contractor project manager and site superintendent / field foreman
 - d. Division 27 project manager and site superintendent / field foreman
 - e. Structured Cabling contractor project manager and site superintendent / field foreman, if different from Division 27 personnel
 - f. Division 26 project manager and site superintendent / field foreman
 - g. Project Architect and Architectural Construction Field Rep
 - 2. Meeting agenda topics shall include:
 - a. Review and coordinate details of Structured Cabling scope, including:
 - 1) Cable labeling schemes
 - 2) Dimensioned telecom room layouts
 - 3) Telecom rack layouts dimensioned in rack units
 - 4) Color schemes for:
 - a) Telecom Outlet cabling
 - b) Telecom Outlet jacks
 - c) Telecom Outlet faceplates
 - 5) Wireless Access Point Telecom Outlet requirements
 - 6) Communications Connecting Cord requirements
 - b. Coordinate division of work among trades.
 - c. Review construction schedule and identify milestones related to Structured Cabling including telecom room turnover dates, test results submittal.
 - 3. Schedule meeting with minimum two weeks' notice.
 - a. Publish agenda for meeting and distribute to invited attendees when meeting is scheduled.
 - 4. Contractor shall take detailed notes during meeting and publish meeting notes within one week after meeting.
 - a. Contractor shall distribute notes to invited attendees and Architect.

3.02 GENERAL

- A. Refer to individual technical specification sections for detailed Cable Routing and Installation, Testing and Documentation requirements. The following apply to communications cabling and termination work.
- B. Installation shall be per manufacturers' recommendations.

3.03 CABLE INSTALLATION

- A. Run cabling in raceways provided, or as designated on floor plans, and support from building structure.
 - 1. Where installed in free-air, support cables using J-hook type cable supports installed in accordance with manufacturer's installation requirements. Refer to Section 27 0529 Hangers and Supports for Communications Systems for installation requirements.
 - a. J-hook fill capacities shall be per manufacturer's recommendations and shall consider diameter of cable type(s) being installed.
 - b. Route cable/hooks at right angles, parallel to construction.
 - 2. Where installed in Cable Tray, lay cables neatly in tray.
 - a. Do not tie.

- b. Provide sufficient slack in cables to allow for unequal expansion coefficients of cable tray and cables. This requirement is in addition to slack required at cable tray expansion joints.
- B. Route and support cable in Equipment Rooms and Telecom Rooms utilizing "D-type" mounting rings, J-hooks and overhead cable runway.
- C. Cable shall be free of tension at both ends.
 - 1. In cases where cable must bear stress, provide Kellems grips to spread stress over longer length of cable.
- D. Provide required installation tools to facilitate cable pulling without damage to cable jacket.
- E. Keep cables clear of other trades work.
- F. During pulling operation provide an adequate number of workers to allow cable observation at points of raceway entry and exit, as well as to feed cable and operate pulling machinery.
- G. Pull cables in accordance with cable manufacturer's recommendations and ANSI/IEEE C2 Standards.
- H. Pull cable by hand unless installation conditions require mechanical assistance.
- I. Do not exceed recommended pulling tensions and bending radii.
 - 1. Where mechanical assistance is used, ensure that maximum tensile load for cable is not exceeded.
 - a. This may be in form of continuous monitoring of pulling tension, use of "break-away" or other approved method.
 - 2. Replace cables bent or kinked to radius less than recommended dimension.
 - a. This shall be at no expense to Owner.
- J. Install cables splice-free unless otherwise specified.
- K. Avoid abrasion and other damage to cables during installation.
- 1. Visually inspect cables for cuts, blisters and abrasions during installation.
- L. Pulling lubricant may be used and shall:
 - 1. Be non-injurious to cable jacket and other materials used.
 - 2. Not harden or become adhesive with age.
- M. Repair damage to interior spaces caused by installation of cable, raceway or other hardware. Repairs must match preexisting color and finish of walls, floors and ceilings.
- N. Replace contractor-damaged ceiling tiles to match color, size, style and texture.
- O. Provide pull cord (200 lb minimum) with cable installed in conduit or innerduct.
- P. Neatly lace, dress and support cabling.
- Q. In vertical pathway, support cables on each floor using industry recognized support methods designed specifically for that purpose.
 - 1. Strap vertical runs as required, to prevent sagging of cables.
- R. To reduce effects of EMI, adhere to the following minimum cable separation distances:
 - 1. 5" from power lines of 2 kVA
 - 2. 18" from high voltage lighting (including fluorescent and LED)
 - 3. When using LED lighting, stated separation distance shall be from cables to LED drivers.
 - 4. 39" from power lines of 5 kVA or greater
 - 5. 47" from transformers and motors

3.04 FIELD TESTING

- A. Refer to Section 27 0500 General Communications Requirements for general guidelines regarding requirements for scheduling and performing compliance testing.
- B. Cabling shall be 100% fault free unless otherwise noted. If any Link is found to be outside specification defined herein, identify and correct problem up to and including replacement of cable and associated termination(s). Then repeat applicable tests.
- C. Test each cabling sub-system (e.g. backbone, horizontal, etc.) end-to-end.

- D. Where sub-systems are to be interconnected or cross-connected by the contractor, test individual sub-system followed by a test of the connected links
 - 1. Performance and documentation requirements shall default to the lesser of the two connected systems if different.
 - 2. Example 1: Combined Backbone-Horizontal Link
 - a. Test and document individual Backbone and Horizontal Cabling Sub-systems.
 - b. Cross-connect sub-systems.
 - c. Repeat testing on combined cabling from MC TO through HC.
 - d. Performance and documentation requirements shall be based in this example on backbone cabling (continuity, pair integrity, etc.).
 - 3. Example 2: Interconnected Zone Cabling Link
 - a. Test and document individual HC CP links.
 - b. Install interconnect cabling CP TO
 - c. Repeat testing on combined cabling from HC TO through CP.
 - d. Performance and documentation requirements shall be based in this example on TIA Permanent Link for Horizontal Cabling.
- E. Test instrument shall be configured using template for exact cable under test (e.g. by manufacturer product designation).
 - 1. If no template is available, enter cable parameters for the cable per manufacturer's product data.
 - a. Nominal Velocity of Propagation (NVP) used for copper cable type under test shall be traceable to manufacturers' product data.
 - b. Refractive Index used for fiber optic cable type under test shall be traceable to manufacturers' product data.
 - 2. Test results obtained using incorrect cable parameters will be rejected.
- F. Test instrument shall be calibrated as defined by instrument manufacturer at least once every 12 months or as required by test instrument manufacturer if that results in more frequent calibration runs.
 - 1. Test instrument calibration date shall be present in test results documentation.
- G. Refer to individual Technical Sections for system-specific guidelines regarding requirements for scheduling and performing compliance testing.

3.05 DOCUMENTATION

- A. Refer to Section 27 0500 General Communications Requirements for general guidelines regarding requirements for project Documentation.
- B. Refer to individual Technical Sections for system-specific guidelines regarding requirements for project Documentation.
- C. Information added by Contractor to Record Drawings shall include:
 - 1. Backbone and horizontal cable routes
 - 2. Telecommunications outlet locations and identification
 - 3. Other detail necessary to document cable installation

3.06 OWNER TRAINING

- A. Provide training for Owner's personnel on operation and maintenance of total system and each component.
- B. Training to include:
 - 1. Overview of System Topology and General Concepts
 - 2. Overview of Product Used
 - 3. Overview of Equipment Room Layouts
 - 4. Overview of Labeling Formats
 - 5. Overview of Test Results and their meaning
 - 6. Overview of Documentation
- C. Training shall be held at Project Site and shall be conducted during normal working hours.
- D. Training session duration shall be not less than two (2) h.

- 1. Provide (1) such session.
- 2. Coordinate with owner to schedule session. Provide adequate notification to allow owner to schedule staff.
- E. Attendance shall be by owner staff.
 - 1. Number of Students per session shall be 6.
 - 2. Materials shall be provided for the number of students indicated.
- F. Provide example course materials and instructor background in advance of training session(s).
- G. Owner may videotape session(s) for use as future refresher materials for owner technical staff.

END OF SECTION

SECTION 27 1100

COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 GENERAL

1.01 SCOPE

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. This section includes product and execution requirements for items unique to communications and not included in Division 26 sections.
- C. Refer to Section 27 05 00 General Communications Requirements.

1.02 RELATED WORK

- A. Related Division 27 Sections include:
 - 1. Section 27 05 00 General Communications Requirements
 - 2. Section 27 05 26 Grounding and Bonding for Communications Systems
 - 3. Section 27 05 28 Pathways for Communications Systems
 - 4. Section 27 05 29 Hangers and Supports for Communications Systems
 - 5. Section 27 05 36 Cable Trays for Communications Systems
 - 6. Section 27 15 00 Communications Horizontal Cabling
- B. Related sections in other Divisions of Work:
 - 1. Section 26 05 48 Seismic Controls for Electrical Systems

1.03 REFERENCES AND STANDARDS

- A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.
- B. Work under this Section is subject to the references and standards requirements of Section 27 05 00 General Communications Requirements.
- C. Additional Standards:
 - 1. ASTM A 123 Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and forged Steel Shapes, Plates, Bars, and Strip.
 - 2. ASTM A 446 Specification for Zinc-Coated (Galvanized) by Hot-Dip Process, Structural (Physical) Quality.
 - 3. ASTM A 525 Specification for Steel Sheet, Zinc-Coated Galvanized by Hot Dip Process.
 - 4. ASTM A 607 Specification for Steel Sheet and Strip, Hot-rolled and Cold-Rolled, High Strength, Low Alloy Columbium or Vanadium.
 - 5. ASTM B 633 Specification for Electro-deposited Coatings of Zinc on Iron and Steel.
 - 6. ASTM A653/A653M-22 Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - 7. ASTM A1011/A1011M-18A Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
 - 8. ASTM A1008/A1008M-21a Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable.
 - 9. ASTM A510/A510M-08 Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
 - 10. ASTM F1136/F1136M-11 Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners
 - 11. ASTM F593-17 Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
 - 12. ASTM F594-09 Specification for Stainless Steel Nuts
 - 13. ASTM D769-01 Specification for Black Synthetic Iron Oxide
 - 14. NEMA VE 1 Metal Cable Tray Systems

- 15. NEMA VE 2 Cable Tray Installation Guidelines
- 16. BICSI Telecommunications Distribution Methods Manual (TDMM)
- D. Definitions
 - 1. Telecommunications spaces will be referred as Building Entrance Facility (EF), Main Distribution Frame (MDF), Intermediate Distribution Frame (IDF), Data Center (DC).

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings shall be under direct supervision of RCDD.
 - 2. Installation Supervision: Installation shall be under direct supervision of Technician, who shall be present at all times when Work of this Section is performed at Project site.
 - 3. Field Inspector: Currently registered by BICSI as RCDD to perform the on-site inspection.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Equipment shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified."

2.02 BACKBOARDS

- A. Backboards: Plywood, Fire Rated, A/C Grade, Fire Rating Stamp on A side, 3/4 by 48 by 96 inches.
- B. A grade side to interior of room.
- C. Mount vertically 12" AFF.
- D. Backboard Paint: Two coats of white paint on all six (6) sides.
- E. Mounting hardware shall also be painted white for cosmetic purposes.
- F. Cover all walls with plywood or as indicated on drawings.

2.03 CABINETS, RACKS, FRAMES AND ENCLOSURES

- A. Manufacturers: CPI, Ortronics, Panduit, or Siemon
 - 1. Equipment racks shall be:
 - a. Constructed of painted aluminum
 - b. Color Black
 - c. Supplied with ground bar 19" wide by 1" high, and #6 AWG ground lugs
 - d. Supplied with minimum of 12 releasable cable support ties (e.g. "hook and loop")
 - e. Supplied with spare screws (minimum of 50)
 - f. Configured with Channel uprights spaced to accommodate industry standard 19" mounting
- B. Free Standing Equipment Rack shall comply with general requirements above and shall:

- 1. Be 84" in height, 2-post or 4-post per drawings and:
 - a. Have minimum of 45 usable rack mounting units (RU)
- 2. Be self-supporting
- 3. Have Minimum base footprint of 15" x 20" for 2-post racks
- 4. Be double-sided drilled and tapped to accept 12-24 screws
 - a. Uprights shall be drilled on back to accept cable brackets, clamps, power strip(s).
 - Hole pattern on rack front and back shall be per EIA/TIA specifications 5/8" 5/8" 1/2".
- C. Cable Management
 - 1. Manufacturers: CPI, Ortronics, Panduit or Siemon
 - 2. Horizontal Cable Management Panels shall:
 - a. Be painted steel
 - b. Be 3.5" high
 - c. Have minimum of 5 distribution rings (3.75" x 3.75" minimum dimension)
 1) Distribution rings shall be painted steel
 - Incorporate cable routing guides and supports on rear of panel.
 - d. Incorporate cable routing guid3. Vertical Cable Management shall:
 - a. Provide for cable routing on front and rear of each rack
 - b. Be 12" wide (minimum) when installed between two racks
 - c. Be 6" wide when installed at end of rack row
 - d. Incorporate cable slack spools.
 - e. Mount on spacers attached to rack uprights and not on upright
 - f. Be accessible from front and rear of rack
 - g. Be designed to space slots/fingers at 1 RU intervals to align with rack-mounted equipment
- D. Equipment Rack Ground Busbar
 - 1. Material: Copper
 - 2. Mounts horizontally in rack
 - 3. Mounting configuration EIA universal mounting hole pattern
- E. Miscellaneous
 - 1. Releasable Cable Support Ties shall be:
 - 2. Hook & Loop type
 - 3. Individual units with latch
 - a. Roll of hook & loop material is not acceptable.

2.04 CABLE RUNWAY

- A. Manufacturers: CPI, B-Line
- B. Cable Runway shall:
 - 1. Be constructed of 0.065" thick steel
 - 2. Utilize tubular stringers to support rungs.
 - a. Stringers shall be 1-1/2" high.
 - b. Rungs shall be welded to stringers and shall be spaced 9" on center.
 - 3. Be painted with black epoxy.
- C. Runway width(s) shall be as shown on drawings.

2.05 TERIMINATION BLOCKS

- A. Manufacturers: Refer to System Requirements list in 27 1000
- B. Blocks shall be 110-style high-density cross-connect blocks.
- C. Each horizontal row of block shall be capable of terminating one 25 pair binder group of Backbone Copper Cable, or six 4 pair Copper Cables.
- D. Mechanical termination on blocks shall:

- 1. Have ability to terminate 22-26 AWG plastic insulated, solid and stranded copper conductors.
- 2. Provide direct connection between horizontal or backbone cable and jumper wires.
- 3. Be designed to maintain cable pair twists as closely as possible to point of mechanical termination.
- E. Blocks for Horizontal Cabling shall use 4-pair connecting blocks; blocks for backbone cabling shall use 5-pair connecting blocks.
 - 1. Blocks shall identify pair position by color designation.
 - a. Colors shall be Blue, Orange, Green and Brown for Horizontal Cables.
 - b. Colors shall be Blue, Orange, Green, Brown and Slate for Backbone Cables.
 - c. Markings shall designate Tip and Ring conductors.
- F. Horizontal Voice/Data/Backbone Blocks shall:
 - 1. Be wall-mounted with legs
 - 2. Meet or exceed TIA Category 6 performance criteria
 - 3. Terminate up to 100 pairs (each block)

2.06 MODULAR PATCH PANELS

- A. Manufacturers: Refer to System Requirements list in 27 1000
- B. Panels shall:
 - 1. Consist of Modular-to-IDC connector system
 - 2. Be rack-mountable in standard EIA 19" equipment racks
 - 3. Be 2 RUs high
 - 4. Be high density angled type
 - 5. Accommodate 48-port modular jacks in two rows of 24-ports
 - 6. Be designed to terminate 4-pair, 100-Ohm UTP cables
 - 7. Have ability to terminate 22-26 AWG plastic insulated, solid and stranded copper conductors.
 - 8. Be designed to maintain cable's pair twists as closely as possible to point of mechanical termination.
 - 9. Have cable support and strain relief devices to secure cables at IDC connector.
 - a. Panel and cable support hardware shall ensure that cabling minimum bend radius requirements are satisfied.
 - 10. Have port identification numbers on both front and rear of panel.
 - 11. Have color-coded pair designations on rear of panel.
- C. Modular Jacks in Panel shall:
 - 1. Be non-keyed, 8 position, 8-conductor (8P8C)
- D. Panels for workstations and WAPs shall meet or exceed TIA Category 6 performance criteria.
- E. Panels for Video Surveillance Cameras shall meet or exceed TIA Category 6A performance criteria.

2.07 FIBER OPTIC PATCH PANELS

- A. Manufacturers: Corning or approved equal
 - 1. MDF:
 - a. CCH-04U Patch Panel for pigtail splicing and CCH-CS splice cassettes
 - 2. Parking Garage IDF:
 - a. CCH-01U Patch Panel for pigtail splicing and CCH-CS splice cassettes
- B. Patch Panels shall:
 - 1. Be enclosed assemblies
 - 2. Incorporate hinged or retractable front cover
 - 3. Be rack mountable on standard TIA 19" equipment racks
 - 4. Provide for strain relief of incoming cables

- 5. Incorporate radius control mechanisms to limit bending of fiber to manufacturer's recommended minimums of 1.2", whichever is larger
- 6. Provide protection to both "facilities" and "user" sides of couplings.
- 7. Be configured to require only front access when patching
- 8. Incorporate patch cable routing space internal to patch panel enclosure.
- a. Routing space shall be front-accessible.
- 9. Include provisions for permanent labeling of fiber optic cables.
 - a. Labeling shall be accessible from front of patch panel and shall not require disassembly of patch panel enclosure or removal of front cover.
- C. Couplings shall be mounted on assembly that snaps into patch panel enclosure.
 - 1. This assembly shall be designed to accept variety of coupler types including, ST, SC, duplex SC and high-density mini-connectors.
 - 2. Coupling type shall be duplex LC
 - 3. Coupling Color shall be as follows:
 - a. Multimode: BEIGE
 - 1) Exception: LASER-optimized 50/125 Multimode couplings shall be AQUA
 - b. Single-mode: BLUE
- D. Access to inside of panel enclosure during installation shall be from front and rear.
 - 1. Panels that require disassembly of cabinet to gain entry will not be accepted.
- E. Incoming cables shall not be accessible from patching area of panel.
 - 1. Enclosure shall provide physical barrier to access of such cables.
 - 2. Where factory-terminated cable assemblies ("pigtails") are spliced to cable, enclosure shall incorporate hardware for securing of splice tray and required cable, buffer tube and pigtail slack.

2.08 ENTRANCE PROTECTION

- A. Manufacturers: Corning, Porta Systems, CommScope, Circa
- B. Interface on Protection devices shall be as follows:
 - 1. Input: 110-type block
 - 2. Output: 110-type block
- C. Entrance protection shall:
 - 1. Be listed primary protector
 - 2. Accommodate industry standard 5 pin protection modules
 - 3. Be provided with grounding lug
- D. Covers on protector housing are required as follows:
 - 1. On input side
- E. Protection modules shall:
 - 1. Be 3-element Gas Tube type
 - 2. Have nominal DC Breakdown voltage of 230V
 - 3. Be self-resetting
 - 4. Provide effective protection against "sneak current" events
 - 5. Have fail-safe design to protect personnel and equipment from exposure to sustained high voltages and currents

2.09 POWER STRIP SURGE SUPPRESSOR

- A. Manufacturers: CPI, Hubbell, Ortronics, Wiremold
- B. Power Strip/Surge Suppressor shall:
 - 1. Be rack mountable in 19" equipment racks
 - 2. Provide Transient suppression to 13,000 A
 - a. Protection shall be in 3 modes (hot-neutral, hot-ground and neutral-ground)
 - 3. Provide High Frequency Noise Suppression:

- a. 20-dB 50-kHz
- b. 40-dB 150-kHz
- c. 80-dB 1-MHZ
- d. 30-dB 6 to 1000 MHZ
- 4. Provide minimum of 320 Joules of AC energy absorption
- 5. Be equipped with minimum 12 ft power cord or coordinated with OFOI rack mount UPS
- 6. Be rated for 20A load at 120V
- C. Vertically mounted suppressors, equip with minimum 10 receptacles.1. Suppressor shall be minimum 48" long.

PART 3 EXECUTION

3.01 GENERAL

- A. Refer to project Drawings for communications equipment room layout and equipment placement.
- B. New communications equipment rooms must be free from dust, dirt, and other foreign materials before installation of any termination hardware or termination of copper or fiber optic cables.
 1. Door to room must be closed during termination if area outside room is not dust-free.
- C. Follow manufacturer's recommended installation and termination practices.
- D. Provide necessary assistance to allow Owner or Carrier personnel to establish service on new cable system.
 - 1. Includes general wiring overview, cable pair identification, and cross connect documentation (if applicable).

3.02 EQUIPMENT RACKS AND CABLE MANAGEMENT

- A. Provide equipment racks as shown on project Drawings.
- B. Assemble racks per manufacturer's recommendations. Remove paint at the point(s) of contact of assembly hardware or use internal-external tooth lock washers to pierce paint to maintain ground continuity.
- C. Bolt racks to floor.
- D. Secure racks to cable runway as described below.
- E. Provide Horizontal and Vertical Cable Management in equipment racks as follows:
 - 1. Horizontal
 - a. Coordinate arrangement and quantity with Owner
 - 2. Provide vertical cable management between adjacent equipment racks and at rack row ends as shown on drawings.
- F. Provide each rack with:
 - 1. Ground bar and #6 AWG Ground lug, mounted at top position
 - 2. Minimum of fifty (50) 12/24 mounting screws,
 - 3. Minimum of twelve (12) releasable (e.g. "hook & loop") cable support ties.
- G. Bond each rack mounted ground bar to telecommunications ground bus bar (TGB).
 - 1. Use #6 AWG or larger copper conductor (green jacket).

3.03 CABLE RUNWAY

- A. Provide cable runway and accessories necessary for complete system.
- B. Size and layout of cable runway shall be as shown on project Drawings.
- C. Install above equipment racks as shown on drawings.
- D. Align with equipment racks as shown on drawings.

- E. Brace to racks with support brackets made by runway or rack manufacturer intended for this purpose.
- F. Use radius drops where cables drop from tray to rack and at elevation changes of 6" or more.
- G. Maximum allowable deviation of runway from level horizontal plane measured across length of cable runway shall be 1/2", with tray loaded to capacity.
- H. Where cable runway is supported from building structure:
 - 1. Provide 3/8" threaded rods for support of 12" wide or smaller runway.
 - 2. Provide 1/2" threaded rods for support of runway greater than 12" in width.
- I. Bond runway components together using manufacturer's standard accessories.
- J. Fasten cables to runway at intervals not to exceed 4 ft.

3.04 TERMINATION BLOCKS

- A. Provide blocks to accommodate an additional 20% growth at each location.
- B. Terminate Backbone Voice Cables on termination blocks.1. Strip lengths & termination of all cabling to be per manufacturers recommendations.
- C. Provide 110 blocks as follows:
 - 1. Backbone Voice Cabling at horizontal cross-connect in wall-mounted patch field.
 - 2. Backbone Voice Cabling at main cross-connect in wall-mounted patch field.
- D. Install Blocks:
 - 1. No higher than 72" AFF to top-most block
 - 2. Top to bottom, left to right beginning no closer than 12" from left wall
- E. Provide horizontal troughs between each termination block.
- F. Provide horizontal troughs at top of each block column.
- G. Provide vertical managers to right and left of each block column.
- H. Cabling entering and exiting fields shall be neatly laced, dressed and supported.
- I. Contractor shall be responsible for jumper wiring between horizontal and backbone cabling.

3.05 MODULAR PATCH PANELS

- A. Provide panels to accommodate an additional 20% growth at each location.
- B. Mount patch panels in 19" equipment racks.
- C. Position cables in sequence of:
 - 1. Telecommunications Outlet ID for horizontal cabling
 - 2. Pair number for backbone cabling
- D. Terminate cables using 568B wiring standard.
- E. Provide minimum of 4 screws to secure each patch panel onto rack.

3.06 FIBER OPTIC PATCH PANELS

- A. Provide Fiber Optic Patch Panels and coupling assemblies at horizontal and main cross-connect locations.
 - 1. Provide minimum of 4 screws to secure each patch panel onto rack.
- B. Provide couplings in coupling assemblies and mount coupling assemblies and blank covers in patch panels.
- C. Position fibers consecutively starting with lowest number and mapped "position for position" between patch panels.
 - 1. There shall be no transpositions in cabling.

- D. Keyways on duplex couplings shall be oriented to establish "cross-over" in cabling system.
 - 1. Convention defined by TIA-568-C.0 (Annex B, Section B.3.2) shall be used.
 - 2. Reverse-pair positioning shall not be used.
- E. Provide blank covers for unused coupling assembly spaces in panels.
- F. Follow manufacturer's guidelines for connector type(s) provided.
 1. Clean connectors with specialized dry-cleaning product from Fluke or Cletop.
- G. Provide dust caps for couplings.
- H. Where factory-terminated cable assemblies ("pigtails") are spliced to cable, prepare and splice cables and fibers per manufacturers' guidelines.

3.07 ENTRANCE PROTECTION

- A. Provide protector at each end on inter-building backbone copper pairs.
 1. Position protector as close as possible to building entrance.
- B. Install per manufacturers recommendations.
- C. Ground protector assemblies to Telecommunications Grounding Busbar via #6 AWG (minimum) conductors.
- D. Provide Protector Modules for 100% of pairs terminated.
- E. If special tool is required to open protector housing, provide 2 such tools to Owner at completion of work.

3.08 POWER STRIP SURGE SUPPRESSOR

A. Provide power strip/surge suppressor in each rack.

3.09 FIELD TESTING

- A. General
 - 1. Refer to Section 27 05 00 General Communications Requirements and 27 1000 Structured Cabling for guidelines regarding documentation requirements.
 - 2. Refer to referenced technical sections for detailed requirements to testing of each cable sub-system.

3.10 DOCUMENTATION

- A. General
 - 1. Refer to Sections 27 0500 General Communications Requirements and 27 1000 Structured Cabling for guidelines regarding documentation requirements.

END OF SECTION

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SECTION 27 1323

COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

PART 1 GENERAL

1.01 SCOPE

A. This section details product and execution requirements for backbone cabling for Communications Systems.

1.02 DESCRIPTION

- A. Backbone Cabling links telecommunications rooms or floor distribution terminals, entrance facilities, and equipment rooms within or between buildings.
- B. Backbone cable types include:
 - 1. Fiber Optic
- C. Refer to Project Drawings which detail Backbone Cable System topology and conductor/fiber counts.

1.03 RELATED WORK

- A. Related Division 27 Sections include:
 - 1. Section 27 05 00 General Communications Requirements
 - 2. Section 27 05 26 Grounding and Bonding for Communications Systems
 - 3. Section 27 05 29 Hangers and Supports for Communications Systems
 - 4. Section 27 05 33 Raceway and Boxes for Communications Systems
 - 5. Section 27 05 36 Cable Tray for Communications Systems
 - 6. Section 27 10 00 Structured Cabling
 - 7. Section 27 11 00 Communications Equipment Room Fittings
 - 8. Section 27 15 00 Communications Horizontal Cabling
- B. Related sections in other Divisions of Work:
 - 1. Refer to individual technical sections identified above (if applicable).

1.04 REFERENCES STANDARDS

A. Refer to Section 27 05 00 - General Communications Requirements and Section 27 10 00 - Structured Cabling which identify pertinent References and Standards.

1.05 DEFINITIONS

A. Refer to Section 27 05 00 - General Communications Requirements and Section 27 10 00 - Structured Cabling which provide information on Definitions used in this and related sections.

1.06 ABBREVIATIONS AND ACRONYMS

A. Refer to Section 27 05 00 - General Communications Requirements and Section 27 10 00 - Structured Cabling which provide information on Abbreviations and Acronyms used in this and related sections.

1.07 WORK BY OWNER

A. Refer to Section 27 05 00 - General Communications Requirements which identifies Work by Owner affecting sub-system(s) covered by this section.

1.08 SUBMITTALS

A. Refer to Section 27 05 00 - General Communications Requirements and Section 27 10 00 - Structured Cabling which provide general guidelines for product or installation information to be submitted by Contractor.

1.09 QUALITY ASSURANCE

A. Refer to Section 27 05 00 - General Communications Requirements and Section 27 10 00 - Structured Cabling which identify general quality assurance requirements for the Project.

1.10 GUARANTEE

- A. Refer to Division 01, General Conditions, and General Requirements Guarantee Documents for general warranty requirements.
- B. Refer to Section 27 10 00 Structured Cabling for particular Warranty requirements for Structured Cabling. Those requirements apply to cable and components covered in this section.

PART 2 PRODUCTS

2.01 GENERAL

- A. Cables and Termination hardware shall be technically compliant with and installed in accordance with referenced TIA documents.
- B. Cables shall be Underwriters Laboratory (UL) listed, comply with Article 800 (Communications Circuits) of National Electrical Code and shall meet specifications of NEMA (low loss), UL 444, and ICEA (where applicable).

2.02 FIBER OPTIC CABLE

- A. General
 - 1. Manufacturers (Optical Fiber): Corning, or approved equal.
 - 2. Fibers utilized in installed cable shall be traceable to manufacturer.
- B. Optical Fiber General
 - 1. Optical fibers shall:
 - a. Be sufficiently free of surface imperfections and occlusions to meet optical, mechanical, and environmental requirements of this specification.
 - b. Have been subjected to minimum tensile proof test by fiber manufacturer equivalent to 100 kpsi.
 - 2. Factory optical fiber splices are not allowed.
 - 3. Coatings shall be mechanically strippable without damaging optical fiber.
- C. 50 micron Multimode Optical Fibers:
 - 1. Fiber Type: Multimode; doped silica core surrounded by concentric glass cladding
 - 2. Strand Count: As shown on Drawings
 - 3. Transmission Windows: 850 nm, 1300 nm
 - 4. Core Diameter: 50 micron ± 3 micron
 - 5. Cladding Diameter: 125 micron ± 2 micron
 - 6. Coating Diameter: 245 micron ± 5 micron
 - 7. Maximum Attenuation:
 - a. 850 nm: 3.5 dB/km (at 23° ± 5°C)
 - b. 1300 nm: 1.5 dB/km (at 23° ± 5°C)
 - c. Attenuation performance is typical for generic 50 micron fiber grades. Better performance is available and can be considered for longer, inter-building links if required. When tested in accordance with FOTP-3, "Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components", average change in attenuation over rated temperature range of cable shall not exceed 0.50 dB/km with 80% of measured fibers not exceeding 0.25 dB/km.
 - 8. Minimum LED Bandwidth:
 - a. 850 nm: 1500 MHz km
 - b. 1300 nm: 500 MHz km
 - 9. Effective Modal Bandwidth:
 - a. 850 nm: 2000 MHz km
 - 10. Point Discontinuity: 0.2 dB at specified wavelengths.
 - 11. Minimum supported Gigabit Ethernet distances shall be:
 - a. 850 nm window: 1000 m
 - b. 1300 nm window: 600 m
- 12. Minimum supported Serial 10 Gigabit Ethernet distances shall be:
 - a. 850 nm window: 300 m
- D. 62.5 micron Multimode Optical Fibers:
 - 1. Fiber Type: Multimode; doped silica core surrounded by concentric glass cladding
 - 2. Strand Count: As shown on drawings
 - 3. Transmission Windows: 850 nm, 1300 nm
 - 4. Core Diameter: 62.5 micron ± 3 micron
 - 5. Cladding Diameter: 125 micron \pm 2 micron
 - 6. Coating Diameter: 245 micron \pm 5 micron
 - 7. Maximum Attenuation
 - a. 850 nm: 3.5 dB/km (at 23° ± 5°C)
 - b. 1300 nm: 1.5 dB/km (at $23^\circ \pm 5^\circ \acute{C}$)
 - c. When tested in accordance with FOTP-3, "Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components", average change in attenuation over rated temperature range of cable shall not exceed 0.50 dB/km with 80% of measured fibers not exceeding 0.25 dB/km.
 - 8. Minimum LED Bandwidth
 - a. 850 nm: 200 MHz km
 - b. 1300 nm: 500 MHz km
 - 9. Effective Modal Bandwidth (850 nm): 385 MHz km
 - 10. Point Discontinuity: 0.2 dB at specified wavelengths.
 - 11. Minimum supported Ethernet distances shall be:
 - a. Gigabit Ethernet at 850 nm window: 500 m
 - b. Gigabit Ethernet at 1300 nm window: 1000 m
 - c. Serial 10 Gigabit Ethernet at 850 nm window: 33 m
- E. Single-mode Optical Fibers:
 - 1. Single-mode Optical Fibers:
 - 2. Fiber Type: Single-mode
 - 3. Strand Count: as shown on Drawings
 - 4. Transmission Windows: 1310 nm, 1550 nm
 - 5. Core Diameter: 8.3 micron
 - 6. Cladding Diameter: 125 micron ± 1 micron
 - 7. Coating Diameter: 245 micron± 10 micron
 - 8. Maximum Attenuation:
 - a. 1310 nm: 0.5 dB/km (at 23° ± 5°C)
 - b. 1550 nm: 0.4-dB/km (at 23° ± 5°C)
 - c. When tested in accordance with FOTP 3, "Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical cable, and Other Passive Fiber Optic Components", average change in attenuation over rated temperature range of cable shall not exceed 0.05 dB/km at 1550 nm. Maximum attenuation change shall not exceed 0.15 dB/km at 1550 nm.
 - d. Water Peak Attenuation: $1383 \pm 3 \text{ nm} (dB/km) \le 0.4$
 - 9. Point Discontinuity: 0.1 dB at specified wavelengths
- F. Indoor Backbone Fiber Optic Cable
 - 1. Cable shall:
 - a. Be suitable for installation in free air, in building risers, in conduit, in cable tray and in innerduct.
 - b. Be dielectric materials (no conductive materials).
 - 2. Cable shall meet the following specifications:
 - a. Buffer Diameter: 900 micron (tight buffer)
 - b. Jacket Color
 - 1) Multimode: ORANGE
 - a) Exception: LASER-optimized 50/125 Multimode: AQUA
 - 2) Śingle-mode: ELLOW
 - 3) Hybrid (Multimode Single-mode): BLACK

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- c. Cable Rating: OFNP
- d. Strength Member: Aramid arn
- e. Storage Temperature: -40°F to 158°F (no irreversible change in attenuation)
- f. Operating Temperature: -34°F to 158°F (no irreversible change in attenuation)
- g. Humidity Range: 0 to 100%
- h. Maximum Tensile Strength:
 - 1) During Installation 2700 N (no irreversible change in attenuation)
 - 2) Long Term 1000 N
- i. Bending Radius:
 - 1) During Installation 20 times cable diameter
 - 2) No Load 10 times cable diameter
- G. Indoor-Outdoor Backbone Fiber Optic Cable
 - 1. Cables shall:
 - a. Incorporate dry water-blocking materials
 - b. Be all dielectric (no conductive materials).
 - c. Be suitable for installation in underground conduit, in innerduct and indoor.
 - 2. Cable shall meet the following specifications:
 - a. Buffer Type: Loose Tube
 - b. Jacket Color: Black or Gray
 - c. Cable Rating: OFNR
 - d. Strength Member: Aramid arn
 - e. Anti-buckling element: fiberglass
 - f. Operating and Storage Temperature: -40°F to 158°F (no irreversible change in attenuation)
 - g. Humidity Range: 0 to 100%
 - h. Maximum Tensile Loading:
 - 1) During Installation 2700 N (no irreversible change in attenuation)
 - 2) Long Term 600 N
 - i. Bending Radius:
 - 1) During Installation 20 times cable diameter
 - 2) No Load 10 times cable diameter

2.03 FIBER OPTIC CONNECTORS

- A. Manufacturers: Corning, Siemon, Panduit, Ortronics.
- B. Connectors shall:
 - 1. Be LC-type.
 - 2. Accept fibers having clad diameter of 125 micron.
 - 3. Accept fibers having buffered diameter of 900 micron.
 - 4. Sustain minimum of 200 mating cycles.
- C. Connector ferrule shall be ceramic or glass-in-ceramic.
- D. Connectors shall meet the following performance criteria: Test Procedure Max. Attenuation Change
 - 1. Cable Retention (TIA-455-6) 0.2 dB
 - 2. Durability (TIA-455-21) 0.2 dB
 - 3. Impact (ANSI/TIA/EIA-455-2) 0.2 dB
 - 4. Temperature Life (TIA/EIA-455-4) 0.2 dB
 - 5. Humidity (TIA/EIA-455-5) 0.2 dB
- E. Optical fiber shall be:
 - 1. Secured within connector ferrule with adhesive, or
 - 2. Mechanically secured and mated to a factory-installed fiber stub that is fully bonded into the ferrule. Mechanical "splice" inside connector shall include an index matching gel.
- F. Attenuation per connector shall not exceed 0.5 dB.
- G. Reflectance (maximum) when mated with patch-cord made up of connectors of comparable design shall be as follows:

- 1. Multimode: -20 dB
- 2. Single-mode: -40 dB
- H. Color of LC Connector shall be as follows:
 - 1. Multimode: BEIGE
 - a. Strain-relief boot of connector terminating LASER-optimized 50 micron fiber shall be AQUA.
 - 2. Single-mode: BLUE

PART 3 EXECUTION

3.01 CABLE INSTALLATION AND TERMINATION

- A. General
 - 1. Provide cables as shown on Project Documents.
 - 2. Size cables as shown on Project Documents.
 - Refer to Section 27 05 00 General Communications Requirements and Section 27 10 00
 Structured Cabling for general cable installation requirements.
- B. Fiber Optic Cable
 - 1. Route backbone fiber optic cable in innerduct.
 - 2. Ground metallic cable sheath (if applicable) per Code.
 - a. Provide armored fiber ground kit for armored cable terminations. Install as directed by kit manufacturer.
 - 1) Ground inter-building cable at one end
 - 2) Ground intra-building cabling at both ends
 - b. Connect armored fiber ground kit to rack mounted grounding reference.
 - 3. Terminate fiber strands on Fiber Optic Connectors mated to couplings mounted in Fiber Optic Patch Panels.
 - a. Terminate all fibers.
 - 4. Follow manufacturer's guidelines for connector type(s) provided.
 - a. Clean connectors with specialized dry-cleaning product from Fluke, ProLabs or Cletop.
 - 5. Fibers with coatings 900 micron shall be furcated (fanned-out) to minimum of 900 micron before termination.
 - a. Provide buffer tube fan-out kits for fibers terminated in patch panel couplings.
 - 6. Provide cable slack in each backbone fiber optic cable.
 - a. Slack shall be in addition to length of fiber required for termination requirements.
 - b. Store cable slack in enclosure designed for this purpose.
 - c. Slack required shall be as follows:
 - 1) Backbone Intra-Building: Minimum of 16 ft (each cable if applicable) coiled and secured at one end (preferably at Telecom Room).
 - 2) Backbone Inter-Building: Minimum of 50 ft (each cable if applicable) coiled and secured at one end (preferably at Equipment Room).
 - 3) Maintenance Holes/Manholes: Minimum of 1-1/2 times inside dimension of Maintenance Hole/Manhole.

3.02 FIELD TESTING

- A. General
 - Refer to Section 27 05 00 General Communications Requirements for general guidelines regarding requirements for scheduling and performance of compliance testing.
 a. Contractor shall be responsible for testing each system end-to-end.
- B. Backbone Fiber Optic Cable Testing
 - 1. Pre-Installation Testing
 - a. Pre-installation testing shall be done at contractor option.
 - b. Submit cable manufacturer's test report for each reel of cable provided.
 - 1) Verify fiber attenuation, bandwidth and length values as specified on cable data sheets supplied with cable reels.
 - c. Visually inspect reels and packaging for damage.

- 2. Post-Installation Testing
 - a. Clean fiber optic connectors before beginning testing.
 - 1) Using fiber tester capable of fiber end face inspection is strongly encouraged to help minimize requirement for retesting due to dirty connectors.
 - b. Testing shall include:
 - 1) Optical Attenuation
 - 2) Optical Time Domain Reflectometry (OTDR)
 - c. Optical Attenuation
 - 1) Light Source: VCSEL for 850 nm tests; FP LASER for 1300 nm tests
 - 2) Measure Optical Attenuation on terminated fibers.
 - a) Include optical connectors and couplings installed at fiber endpoints.
 - 3) Test multimode fibers using TIA 526-14-C, Annex A.
 - 4) Test single-mode fibers using TIA 526-7-A. Annex E (Method A).
 - 5) Test fibers in both transmission directions.
 - 6) Test multimode fibers at 850 ± 30 nm and 1300 ± 20 nm wavelengths.
 - 7) Test single-mode fibers at 1310 ± 10 nm and 1550 ± 10 nm wavelengths.
 - 8) Fiber lengths less than or equal to 300 ft shall test to \leq 2.0 dB loss.
 - 9) Fiber lengths greater than 300 ft shall test to loss value less than link loss budget for installed connectors and fibers.
 - d. Optical Time Domain Reflectometry (OTDR)
 - 1) OTDR testing shall not be used as the sole method for establishing optical attenuation link loss.
 - 2) Verify fiber integrity using an Optical Time Domain Reflectometer (OTDR).a) Includes terminated and (if applicable) un-terminated fibers.
 - OTDR(s) shall incorporate high-resolution optics and short pulse-width options optimized for viewing of short cable sections.
 - a) Pulse-width shall be 10-ns or less for cable lengths greater than 100 meters.
 - b) Pulse-width shall be 5-ns or less for cable lengths less than 100 meters.
 - 4) OTDR traces shall be performed in two directions using access jumpers at transmit and receive ends
 - a) Remote end of tail cord shall meet same reference grade requirements as launch end cord.
 - b) Perform bi-directional OTDR measurements according to requirements of TIA-526-7-A, clauses H.6 and H.7.
 - c) Minimum length of access jumper at launch end shall be minimum 330 ft long for multimode or 990 ft long for single-mode, unless recommended otherwise by test equipment manufacturer.
 - 5) Test multimode fibers at 850 ± 30 nm wavelength.
 - 6) Test single-mode fibers at 1310 ± 10 nm wavelengths.
 - 7) Examine traces for continuity and anomalies to confirm fiber link integrity.
 - a) Point discontinuities in excess of 0.2 dB for multimode fibers or 0.1 dB for single-mode fibers shall be cause for rejection of cable.
 - b) Any reflection in trace except at patch panels shall be cause for rejection of cable.
 - c) Submitted test results shall show only fiber under test and shall have trace boundaries set to show fiber under test and not launch cords or other extraneous data.
 - d) Set event markers to accurately reflect overall attenuation of installed fiber optic cable and connectors.
 - 8) OTDR tested links showing excessive backscatter immediately following connector shall have connector cleaned and/or re-polished and then retested.

3.03 DOCUMENTATION

- A. General
 - 1. Refer to Section 27 05 00 General Communications Requirements for general guidelines regarding documentation requirements.
- B. Backbone Fiber Optic Cable
 - 1. Files containing Attenuation and OTDR traces of individual optical fiber "signatures" shall be so named as to identify each individual fiber by location in cable system and fiber number or color.
 - 2. OTDR test results shall be consistent in format and presentation, including:
 - a. Scale
 - 1) Scale or window of test result view shall show only enough trace to view fiber under test plus launch cords at both ends.
 - 2) View shall not show backscatter beyond end of fiber.
 - b. Pulse width
 - c. Units (English or Metric)
 - d. Cursor placement
 - e. Labeling

END OF SECTION

SECTION 27 1500

COMMUNICATIONS HORIZONTAL CABLING

PART 1 GENERAL

1.01 SCOPE

A. This section details product and execution requirements for Horizontal (Station) Cabling for Communications Systems.

1.02 DESCRIPTION

- A. Systems shall include cabling, termination hardware and active components, installed as indicated on drawings and specifications.
- B. Cables and equipment shall be provided, tested, and terminated, including proper grounding and bonding.
- C. Communications Horizontal cabling subsystem is portion of communication link that connects horizontal or intermediate cross-connect (typically at Telecom Room) and Telecommunications Outlet as part of a cabling system.
 - 1. Horizontal Cable types include:
 - a. 4-pair Copper Unshielded Twisted Pair (UTP)
 - b. Coaxial

1.03 RELATED WORK

- A. Refer to Section 27 05 00 General Communications Requirements and Section 27 10 00 Structured which identifies pertinent related specifications.
- B. Related sections in other Divisions of Work:
 - 1. Refer to individual technical sections identified above (if applicable).

1.04 REFERENCES AND STANDARDS

A. Refer to Section 27 05 00 - General Communications Requirements and Section 27 10 00 – Structured Cabling which identifies pertinent References and Standards.

1.05 DEFINITIONS

- A. Refer to Section 27 05 00 General Communications Requirements and Section 27 10 00 Structured Cabling for general terminology used in Division 27 sections.
- B. In this section, "Telecommunications Outlet" is considered to consist of Frame/Faceplate into which Modular Jacks or other couplings snap, Modular Jacks, blanks fitted to unused jack positions, and labeling/identification components.

1.06 ABBREVIATIONS AND ACRONYMS

A. Refer to Section 27 05 00 - General Communications Requirements and Section 27 10 00 – Structured Cabling which provide information on Abbreviations and Acronyms used in this and related Sections.

1.07 DIVISION OF WORK BETWEEN OWNER AND CONTRACTORS

A. Refer to Section 27 05 00 - General Communications Requirements which identifies Work by Owner affecting sub-system(s) covered by this section.

1.08 SUBMITTALS

- A. Refer to Section 27 05 00 General Communications Requirements and Section 27 10 00 -Structured Cabling which provide general guidelines for product or installation information to be submitted by Contractor.
- B. In addition, submit:
 - 1. Samples of each Telecommunications Outlet Faceplate type to confirm color and material.
 - 2. One 3-foot section of each cable type from cable reels sent to site for Engineer's final approval.
 - a. Section shall have manufacturer's cable markings visible.

3. Nominal Velocity of Propagation (NVP) for 4-pair Horizontal Copper Cable.

1.09 QUALITY ASSURANCE

A. Refer to Section 27 05 00 - General Communications Requirements and Section 27 10 00 - Structured Cabling which identify general quality assurance requirements for the Project.

1.10 GUARANTEE

- A. Refer to Division 01, General Conditions, and General Requirements Guarantee Documents for general warranty requirements.
- B. Refer to Section 27 10 00 Structured Cabling for particular Warranty requirements for Structured Cabling. Those requirements apply to all cable and components covered in this section.

PART 2 PRODUCTS

2.01 GENERAL

- A. Cables and Termination hardware shall be technically compliant with and installed in accordance with referenced TIA documents.
- B. Cables shall be Underwriters Laboratory (UL) listed, comply with Article 800 (Communications Circuits) of National Electrical Code and shall meet specifications of NEMA (low loss), UL 444, and ICEA (where applicable).
- C. Horizontal (Station) Cable and Termination Components (Jack, Patch Panel) are specified to function as System.
 - 1. Where required for warranty purposes, manufacturers of cabling and termination components used (if more than one) shall recognize each other in their Certification Programs.
- D. 4-Pair Horizontal Copper Cables and Modular Jacks are application independent (e.g. no distinction between "voice" and "data")

2.02 4 PAIR HORIZONTAL COPPER CABLE

- A. Manufacturers: Refer to System Requirements list in 27 1000
- B. Cables shall be suitable for installation in environment defined
- C. Cabling shall be packaged to minimize tangling and kinking of cable during installation.
- D. Configuration:
 - 1. Number of Pairs: 4 twisted pair
 - a. Pair twists of any pair shall not be same as any other pair.
 - b. Pair twist lengths shall be selected by manufacturer to ensure compliance with crosstalk requirements of TIA 568.
 - 2. Conductors: insulated solid annealed copper pairs
 - a. Category 3 5e: 24 AWG
 - b. Category 6 & 6A: 23 AWG
 - c. Pairs of 4-pair cables shall be identified by banded color code in which conductor insulation is marked with dominant color and banded with contrasting color.
 - 1) By pair number, pair colors or dominant band are:
 - a) Pair 1: Tip White/Blue; Ring Blue (or Blue/White)
 - b) Pair 2: Tip White/Orange; Ring Orange (or Orange/White)
 - c) Pair 3: Tip White/Green; Ring Green (or Green/White)
 - d) Pair 4: Tip White/Brown; Ring Brown (or Brown/White)
 - 3. Shield: None
 - a. Drain Wire: None
 - 4. Cable Rating: NEC Article 800 Type CMP, UL listed
 - 5. Maximum outside diameter:
 - a. Category 6: 0.25 inches
 - b. Category 6A: 0.28 inches

- 6. Cable routed thru wet locations shall be listed as such in addition to riser/plenum if cable routing requires.
- E. Horizontal Data/Voice Cable:
 - 1. Shall meet or exceed TIA Category 6 or TIA Category 6A performance requirements as applicable.
 - 2. Shall not incorporate an overall shield.
 - 3. Jacket Color: Refer to Telecommunications Configuration Schedule on Drawings.
- F. Horizontal Cable for Building Automation:
 - 1. Shall meet or exceed Category 6 performance requirements.
 - 2. Shall not incorporate an overall shield.

2.03 HORIZONTAL COAXIAL CABLE

- A. Manufacturers: CommScope, Belden.
- B. Cables shall be suitable for installation in environment defined and shall meet Riser CATVR rating (or permitted substitute as defined by NEC).
- C. Station Coaxial Cable shall be Series 6 (RG-6) type, Dual-shield
- D. Coaxial cable shall be sweep tested 5 MHz to 2.25 GHz.
- E. Series 6 (RG-6) Type (Dual-shield)
 - 1. Center conductor: 18 AWG copper-clad steel.
 - 2. Dielectric: Gas expanded (foamed) polyethylene.
 - 3. First shield: Aluminum-polypropylene-aluminum laminated tape with overlap bonded to dielectric.
 - 4. Second shield: 34 AWG aluminum braid wire (60% coverage).
 - 5. Impedance: 75 ± 3 ohms
 - 6. Velocity of Propagation: 83% nominal
 - 7. Maximum Attenuation 68°F:
 - a. 55 MHz: 1.60 dB/100 ft
 - b. 750 MHz: 6.6 dB/100 ft
 - c. 1 GHz: 8.2 dB/100 ft
- F. Series 6 (RG-6) Type (Quad-shield)
 - 1. Center Conductor: 18 AWG copper-clad steel.
 - 2. Dielectric: Gas expanded (foamed) polyethylene.
 - 3. First shield: Aluminum-polypropylene-aluminum laminated tape with overlap bonded to dielectric.
 - 4. Second shield: 34 AWG aluminum braid wire (60% coverage).
 - 5. Third shield: Non-bonded foil shield.
 - 6. Fourth shield: 34 AWG aluminum braid wire (60% coverage).
 - 7. Impedance: 75 ± 3 ohms
 - 8. Velocity of Propagation: 83% nominal
 - 9. Maximum Attenuation 68°F:
 - a. 55 MHz: 1.60 dB/100 ft
 - b. 750 MHz: 5.65 dB/100 ft
 - c. 1 GHz: 6.1 dB/100 ft

2.04 TELECOMMUNICATIONS OUTLET

- A. Manufacturers: Refer to System Requirements list in 27 10 00.
- B. Connectors (modular jacks, fiber optic couplings, and coaxial connectors, each as applicable) shall snap onto faceplate.
 - 1. In surface-mount designs (if applicable) Jacks and connectors may mount to frame onto which coverplate is mounted.
- C. Work Area Faceplate
 - 1. Wall-mounted faceplates intended to be used in general work areas shall:
 - a. Be configured to mount on standard, single gang opening when wall mounted.

- b. Accommodate minimum of 6 modular jacks and connectors, configuration as detailed on drawings in Telecommunications Outlet Configuration Schedule.
- c. Be constructed of high impact plastic (except where otherwise noted).
- d. Incorporate recessed designation strips at top and bottom of frame for identifying labels.
 - 1) Triple row faceplates with no provisions for labeling of middle outlet row are not acceptable.
 - 2) Designation strips shall be fitted with clear plastic covers.
 - 3) Designation strips and covers shall be positioned over faceplate mounting screws.
- 2. Faceplate Color: to match electrical device faceplates.
- D. Wall-mount Telephone Faceplate
 - 1. Faceplates intended to be used in locations where wall mounted telephone set is required shall:
 - a. Be stainless steel construction.
 - b. Accommodate 1 modular jack meeting performance requirements for "Voice" jack as defined above (data jack if no differentiation).
 - 1) Modular jack shall be positioned to mate with wall-mounted telephone.
 - c. Mount on standard single gang opening.
 - d. Include mating lugs for mounting wall-mounted telephone.
 - e. Maintain 8" clearance around faceplate to avoid obstruction of telephone when mounted.
- E. Faceplate Wireless Access Point Location
 - 1. Faceplates supporting Wireless Access Point (AP) shall:
 - a. Accept 2 modular jacks or connectors.
 - b. Be Surface-mounted above in open ceiling areas and flush-mounted in ceiling locations.
 - c. Be made of High Impact thermoplastic.
 - 2. Faceplate Color: to match electrical device faceplates.

2.05 MODULAR ACK

- A. Manufacturers: Refer to "Telecommunications Outlet" above.
- B. Modular Jacks shall be:
 - 1. 8-position, 8-conductor (8P8C)
 - 2. Non-keyed
- C. Jacks shall have an attached color-coded wiring instruction label as an aid to installer.
- D. Interface between jack and station cable shall be insulation displacement type contact.
- E. Termination components shall maintain cable's pair twists as closely as possible to point of mechanical termination.
- F. Jack contacts shall have minimum of 50 micro-inches of gold plating.
- G. Jacks shall be supplied with installed dust covers to protect jack opening and internal elements during installation until jack is in use.
 - 1. No damage to Jack pinning shall result from insertion or removal of covers.
- H. Data/Voice Jack shall:
 - 1. Meet or exceed performance requirements of TIA Category 6 or TIA Category 6A as applicable.
 - 2. Be color as designated on drawings in Telecommunications Outlet Configuration Schedule.
- I. MPTL connector shall
 - 1. Meet or exceed performance requirements of TIA Category 6 or TIA Category 6A as applicable.
 - 2. Comply with Annex F of TIA-568.2-D.

2.06 COAXIAL CONNECTOR

- A. Coaxial Connectors shall be threaded male F-type.
- B. Male F-connectors shall:
 - 1. Be matched to cable type(s) used.
 - 2. Be single piece connector.
- C. Use female/female feed-through couplings for coaxial outlets and patch panels (if applicable).
- D. Be color to match faceplate color.

PART 3 EXECUTION

3.01 GENERAL

- A. Refer to project Drawings for outlet locations.
- B. Provide Modular Jacks, Coaxial Connectors (if applicable) and Fiber Optic couplings (if applicable) in faceplates as shown on Project Documents.
- C. Maximum length of 4-pair Category-rated horizontal cable shall not exceed 295 feet (90 m) measured from horizontal cross-connect (typically at TR) to Telecommunications Outlet.
 - 1. Includes slack required for installation and termination.
 - 2. Contractor is responsible for installing station cable to avoid unnecessarily long runs.
 - 3. Any area that cannot be reached within above constraints shall be identified and reported to Engineer prior to installation.
- D. Follow manufacturers recommended termination practices.

3.02 CABLE INSTALLATION AND TERMINATION

- A. General
 - 1. Refer to Section 27 05 00- General Communications Requirements and Section 27 10 00-Structured Cabling for general cable installation requirements.
 - 2. Provide "Service Loop" for every Horizontal Cable in ceiling above outlet.
 - a. Loop length shall be 3.3ft
 - b. Total length of 4-pair Category-rated horizontal cable including loop shall not exceed 295 feet (90 m).
 - c. Place loop in ceiling at last support (e.g., J-Hook) before cables enter fishable wall, conduit, surface raceway or box.
 - d. Coil loop in figure 8 configuration.
 - e. Loop radius (minimum) shall be 4 minimum bend radius for cable.
 - 3. During installation, minimum bend radius shall be eight times outside diameter of UTP cables and 20 times outside diameter of fiber cables.
- B. Horizontal Copper Twisted-Pair Cabling
 - 1. Provide horizontal copper twisted pair cable between horizontal cross connect (typically at Telecommunications Room) and Telecommunications Outlet.
 - 2. At Telecommunications Outlet, terminate each 4-pair Horizontal Cable on 8P8C Modular Jack.
 - a. Terminating one cable on more than one jack is not allowed.
 - 3. At horizontal cross-connect, terminate:
 - a. Each 4-pair cable on 8P8C Modular Jack in Patch Panel.
 - 4. Terminate cables using 568B wiring standard.
 - 5. Cable jacket shall be continuous to within ½-inch of termination.
 - 6. Preserve pair twists to point of termination.
 - 7. Refer to Section 27 11 00 Communications Equipment Room Fittings for termination instructions for Modular Patch Panel and Termination Block.
- C. Horizontal Coaxial Cable
 - 1. Provide horizontal coaxial cable between Telecommunications Room(s) and coaxial workstation outlets.
 - 2. At Telecommunications Room(s):
 - a. Terminate cables in specified connector type.

- 1) Prepare cables per manufacturers recommendations for connector type used.
- 2) Ensure proper center conductor length as specified by manufacturer.
- 3. Coordinate splitter location with Owner to ensure adequate cable lengths.
- 4. At Coax Outlet, mate Male with Female port on Tap or Female/Female Feed-thru Coupling, whichever is applicable for the outlet type specified.

3.03 TELECOMMUNICATIONS OUTLET

- A. Faceplates shall be configured to provide connectivity as required by location. Refer to Drawings for Telecommunications Configuration Schedule.
- B. Mount modular jacks and connectors into faceplates and secure faceplates to outlet box, raceway or modular furniture.
 - 1. Use faceplate extender if required to provide adequate clearance between jack and furniture or raceway panel to maintain minimum cable bend radius.
 - 2. Provide blank(s) in unused jack/connector positions. Match color of blank to faceplate color.
- C. Position Telecommunications Outlet for wall-mounted telephone in area clear of other utilities and wall mounted hardware.
 - 1. Coordinate with other trades to maintain 8-inch clear space (minimum) on all sides from faceplate centerline.
- D. MPTL connectors shall be installed following connector manufacturer requirements.
 - 1. Contractor shall ensure installed MPTL will fit in available space at outlet-end of cable while maintaining cable bend radius requirements.

3.04 FIELD TESTING

- A. Refer to Sections 27 05 00 General Communications Requirements and 27 10 00 Structured Cabling for guidelines regarding testing requirements common to all Division 27 Structured Cabling sections.
 - 1. In addition, refer to sub-sections below for cable type under test.
- B. 4-Pair Horizontal Copper Cable
 - 1. Test from:
 - a. Horizontal Cross-connect (HC) to Jack at Telecommunications Outlet (TO).
 - 2. Testing shall be per TIA-568 Permanent Link test configurations.
 - 3. Maximum length of station cable shall not exceed 300 ft.
 - 4. Cables shall be free of shorts within pairs, and be verified for Continuity, Pair Validity and Polarity, and Wire Map (Conductor Position on Modular Jack).
 - a. Identify and correct defective, split or mis-positioned pairs. In addition to above, Performance Testing shall be performed on all cables. Testing of
 - In addition to above, Performance Testing shall be performed on all cat Transmission Performance shall include the following:
 - a. Length
 - b. Insertion Loss / Attenuation
 - c. Pair-to-pair NE T (Near End Crosstalk)
 - d. PSNE T (Power Sum Near End Crosstalk)
 - e. Pair-to-pair ELFE T (Equal Level Far End Crosstalk)
 - f. PSELFE T (Power Sum Equal Level Far End Crosstalk)
 - g. Return Loss
 - h. Propagation Delay
 - i. Delay Skew
 - j. A T (Alien Crosstalk) 10G Cable Systems only (WAP and Camera)
 - 1) A T measurement method shall be as required by the manufacturer(s) of cabling/connecting components installed to certify the system for warranty.
 - k. DC Loop Resistance and DC Resistance Unbalance (Pair and Pair-to-Pair values)
 - 1) Configure test equipment to include DC Loop Resistance and DC Resistance Unbalance as criteria for setting PASS/FAIL for each item under test.

- a) For example, when using Fluke test equipment, select "+PoE" test limit, and when using IDEAL test equipment select "MAX" test limit when setting test parameters.
- 6. Test cables to maximum frequency defined by standards covering specified performance category.
- 7. Perform Transmission Performance Testing using test instrument designed for testing to specified frequencies.
 - a. Test records shall verify "PASS" on each cable and display specified parameters comparing test values with standards based "templates" integral to unit.
- 8. MPTL cables shall be tested in accordance with TIA-568.2-D, Annex F, and test procedure shall follow recommended guidelines of test equipment manufacturer.
 - a. Select MPTL test limit on test equipment when testing MPTL terminated cables.
- C. Horizontal Coax Cable
 - 1. All cables shall be tested using Wire Test Instrument to:
 - a. Verify length
 - b. Verify Resistance
 - c. Verify impedance
 - d. Locate breaks/faults/incorrect terminations and large impedance changes
 - 2. Terminate cable as required by individual tests with its characteristic impedance.

3.05 DOCUMENTATION

- A. Refer to Sections 27 0500 General Communications Requirements and 27 1000 Structured Cabling for documentation guidelines.
- B. Information added by Contractor to Record Drawings relating to Horizontal Cabling shall include cable routes, outlet locations and numbering, location of Consolidation Points and other detail necessary to document cable installation.

END OF SECTION

SECTION 27 5129

TWO WAY COMMUNICATION SYSTEM

PART 1 - GENERAL

1.01 SCOPE

- A. This section includes product and execution requirements for Two-way Communication System.
- B. Refer to Section 27 0500 General Communications Requirements.
- C. Complete, turnkey Two-way Communication system compliant with all applicable codes and standards referenced herein and as indicated on drawings.
- D. Two-way Communication system shall include the following major components:
 - 1. Two-way Communication Call Stations
 - 2. Two-way Communication Master Stations
 - 3. Two-way Communication Power Supplies

1.02 RELATED WORK

- A. Refer to Section 27 05 00 General Communications Requirements, which identifies pertinent related specifications.
- B. Related sections in other Divisions of Work:
 - 1. Refer to individual technical sections identified above (if applicable).

1.03 REQUIREMENTS OF REGULATORY AGENCIES

A. Refer to Section 27 05 00 - General Communications Requirements.

1.04 REFERENCES AND STANDARDS

- A. Refer to Section 27 05 00 General Communications Requirements.
- B. In addition, design, cable and component selection, and installation practices shall conform with following:
 - 1. OSSC Oregon Structural Specialty Code
 - 2. NFPA 70 National Electrical Code
 - 3. NFPA 72 National Fire Alarm and Signaling Code
 - 4. UL 2525 Standard for Two-Way Emergency Communications Systems for Rescue Assistance

1.05 ABBREVIATIONS AND ACRONYMS

A. Refer to Section 27 05 00 - General Communications Requirements for general terminology used in Division 27 sections.

1.06 WORK BY OWNER

A. Refer to Section 27 05 00 - General Communications Requirements.

1.07 SUBMITTALS

A. Refer to Section 27 05 00 - General Communications Requirements.

1.08 AUTHORITY HAVING URISDICTION REVIEW MEETING

- A. Prior to shop drawing submittal preparation, Contractor shall arrange and conduct meeting with Authority Having Jurisdiction (AHJ) to review and coordinate design and installation of Two-Way Communication system.
 - 1. At minimum, attendees shall include:
 - a. AHJ
 - b. Owner's project manager, facilities/buildings and grounds/maintenance representative, security representative, and information technology/information systems representative
 - c. Construction Manager, General Contractor, project manager and site superintendent/field foreman
 - d. Division 26 site superintendent/field foreman

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- e. Division 27 project manager and site superintendent/field foreman
- f. Two-Way Communication system subcontractor/supplier project manager
- 2. At minimum, meeting agenda topics shall include:
 - a. Review of proposed system equipment and devices
 - b. Identification and discussion of proposed system's functional capabilities and limitations
 - c. Identification and review of device locations
 - d. Step-by-step review of system deployment execution plan
 - e. Review of installation, configuration, programming, and testing schedule and of how those relate to overall construction schedule, including identification of interdependencies, project milestones, and critical dates.
- 3. Meeting shall be scheduled with two weeks' minimum notice.
 - a. Contractor shall publish meeting agenda and distribute agenda and configuration and programming guide to invited attendees minimum of one week prior to meeting.
- 4. Contractor shall take detailed notes during meeting and publish meeting minutes within one week after meeting. Minutes shall be distributed to attendees, Architect, and Engineer, and be included in Operation and Maintenance Manual.

1.09 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace system equipment and components that fail because of defects in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 1 year from date of Substantial Completion.
 - 2. Guarantee all work against faulty and improper material and workmanship for a minimum of 1 year from the date of final written acceptance by the Owner, except where guarantee or warranties for longer terms are clearly requested and specified.
 - 3. Upon notification of a problem, the warranty provider shall furnish within 48 hours, at no cost to the Owner, such labor and materials as are needed to restore the system to proper operation.
 - 4. During the entire 1-year warranty period the Contractor shall guarantee a 24-hour response time for problem resolution.
 - 5. During the entire 1-year warranty period the Contractor shall provide all related software and firmware upgrades to the installed system(s). Following the initial 1-year warranty period, any software/firmware changes and/or updates that impact the life safety and/or panel function shall be provided at no additional cost to the Owner for 3 additional years.

PART 2 - PRODUCTS

2.01 GENERAL

- A. System shall provide full-duplex two-way voice communication between call stations and master station.
- B. System shall be listed as compliant with and meeting requirements of UL 2525.
- C. If master station is not answered, system shall provide full-duplex two-way voice communication with external constantly attended station and shall automatically communicate location of station initiating call using pre-recorded message unique to each call station.

2.02 TWO WAY COMMUNICATIONS CALL STATIONS

- A. Basis of Design:
 - 1. Rath 2500 SmartRescue System
- B. Acceptable Alternates:
 - 1. Cornell
- C. Features:
 - 1. Flush wall-mounted
 - 2. Confirm devices can be flush mounted in required locations. Consider that some stairwell types in particular may necessitate a surface mounted device.
 - 3. Stainless steel faceplate
 - 4. Red mushroom-style pushbutton

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- 5. Red "call received" indicator lamp
- 6. Microphone
 - a. Auto-gain adjustment to account for variable ambient sound level at call station locations
- 7. Speaker
 - a. Auto-level adjustment to account for variable ambient sound level at call station locations
- D. Specifications:
 - 1. Operating Environment: 50° 120° F

2.03 TWO WAY COMMUNICATIONS MASTER STATIONS

- A. Basis of Design:
 - 1. Rath 2500-205FM
- B. Acceptable Alternates:
- 1. Cornell
- C. Features:
 - 1. Flush wall-mounted
 - 2. Powder-coated steel enclosure with hinged door
 - 3. Visual and audible indication of incoming call
 - 4. Handset
 - 5. Handsfree speakerphone
 - 6. Modem for automatic dial-out
- D. Specifications:
 - 1. Operating Environment: 50° 120° F

2.04 TWO WAY COMMUNICATIONS POWER SUPPLIES

- A. Basis of Design:
 - 1. Rath 2500-PWR24U
- B. Acceptable Alternates:
 - 1. Cornell
- C. Features:
 - 1. Integral battery backup
 - 2. Secondary power supply (battery backup) shall have sufficient capacity to operate system under quiescent load (system operating in nonalarm condition) for minimum of 24 hours and, at end of that period, shall be capable of operating all alarm notification appliances used for evacuation or to direct aid to location of emergency for 5 minutes.
- D. Specifications:
 - 1. Input: 120 VAC
 - 2. Output 24 VDC

2.05 TWO WAY COMMUNICATIONS CABLE

- A. General
 - 1. Refer to manufacturer's published product installation instructions for additional information and requirements. Wherever a discrepancy is identified between Project Documents and manufacturer's published product installation instructions, more stringent requirement shall govern.
 - 2. Čable shall be plenum or riser rated as dictated by environment in which cable is installed.
 - 3. Cable installed in wet or damp locations, including, but not limited to, in-slab and buried conduit, shall be rated for installation in wet locations.
 - 4. Two-way Communications system cabling shall be UL 2196 certified and have minimum pathway survivability of Level 2, 3, or 4 as defined in NFPA72, section 12.4:
 - a. Pathway Survivability Level 2:
 - Pathway survivability Level 2 shall consist of one or more of the following:
 a) 2-hour fire-rated circuit integrity (CI) or fire-resistive cable

- b) 2-hour fire-rated cable system (electrical circuit protective system)
- c) 2-hour fire-rated enclosure or protected area
- d) Performance alternatives approved by the authority having jurisdiction
- b. Pathway Survivability Level 3:
 - 1) Pathway survivability Level 3 shall consist of pathways in buildings that are fully protected by an automatic sprinkler system in accordance with NFPA 13 and one or more of the following:
 - a) 2-hour fire-rated circuit integrity (CI) or fire-resistive cable
 - b) 2-hour fire-rated cable system (electrical circuit protective system)
 - c) 2-hour fire-rated enclosure or protected area
 - d) Performance alternatives approved by the authority having jurisdiction
- c. Pathway Survivability Level 4:
 - 1) Pathway survivability Level 4 shall consist of one or more of the following:
 - a) 1-hour fire-rated circuit integrity (CI) or fire-resistive cable
 - b) 1-hour fire-rated cable system (electrical circuit protective systems)
 - c) 1-hour fire-rated enclosure or protected area
 - d) Performance alternatives approved by the authority having jurisdiction

2.06 TWO WAY COMMUNICATION TYPE CABLE SUPPORT HOOKS

A. Refer to related sections for information and requirements

2.07 TWO WAY COMMUNICATION RACEWAY AND BOXES

- A. Refer to related sections for additional information and requirements.
- B. Conduit:
 - 1. Minimum ³/₄-inch trade size.
 - 2. No flexible conduit of any type.
- C. Boxes:
 - 1. Minimum 4 inches square, 2-1/8-inch deep.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General
 - 1. Wiring color coding for each device type shall be consistent throughout installation.
- B. System Supervision
 - 1. Two-way telephone communications circuit installation conductors shall be monitored for open circuit and short circuit fault conditions that would cause the telephone communications circuit to become fully or partially inoperative.
 - a. Two-way telephone communications circuit fault conditions shall result in trouble signal in accordance with Section 24.10 of NFPA 72.
 - 2. Failure of either primary or secondary power supply shall result in trouble signal in accordance with section 24.10 of NFPA 72.
- C. Two-way Communications Call Stations
 - 1. Coordinate rough-in requirements with Division 26 Contractor prior to commencement of work on site.
 - 2. Coordinate exact locations with Owner, Architectural elevations, and work by other trades prior to rough-in.
 - 3. Install in accordance with Americans with Disabilities Act and Americans with Disabilities Act Accessibility Guidelines.
- D. Two-way Communications Master Stations
 - 1. Coordinate rough-in requirements with Division 26 Contractor prior to commencement of work on site.
 - 2. Coordinate exact locations with Owner, Architectural elevations, and work by other trades prior to rough-in.
 - 3. Install in accordance with Americans with Disabilities Act and Americans with Disabilities Act Accessibility Guidelines.

- E. Cable
 - 1. Systems Identification:
 - a. Label system device cabling with unique alphanumeric identifiers that include:
 - 1) Architectural room number
 - 2) Associated system device type
 - 3) Unique alphanumeric identifier
 - b. Refer to related Sections for additional information and requirements.
- F. Configuration and Programming
 - 1. Coordinate programming with Owner.

3.02 TESTING

- A. Schedule and perform system testing with Owner and AHJ present to witness and approve test results.
- B. System testing shall include verified acceptable call quality:
 - 1. From each call station to each master station
 - 2. From each call station to external constantly attended station, using voice circuit configured for remote attended station access
- C. Each call path shall be tested at:
 - 1. Typical ambient background noise levels at call station and master station
 - 2. Active fire alarm background noise levels at call station and master station
- D. Each call station shall be tested to verify proper pre-recorded message unique to each call station is played before initiating two-way voice communication with master station or external constantly attended station.
 - 1. Alternatively, calls to master station can use visual indication of calling station location in lieu of pre-recorded message.
 - a. Calls to external constantly attended station shall still include pre-recorded message.

3.03 TRAINING

A. Contractor shall provide to Owner's designated representative(s) a minimum of one (1) 1-hour on-site training session related to work under this section within thirty (30) days of substantial completion.

END OF SECTION

SECTION 28 3100

ADDRESSABLE FIRE ALARM SYSTEMS

PART 1 GENERAL

1.01 SCOPE

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- This section includes product and execution requirements for items unique to Life Safety and Β. not included in Division 26 sections.
- Work under this Section and related sections is subject to requirements of Owner standards C. and specifications, Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements. Should conflicting requirements occur, the most stringent requirements shall govern unless otherwise approved. The contractor shall notify the Engineer of Record about the conflicting requirements prior to purchasing equipment/materials, and prior to rough-in.
- D. Contractor shall verify all finishes of material and equipment with Architect and Owner prior to purchase or rough-in and immediately inform Engineer of Record regarding any deviations from color or finish contained within Division 27 and 28 specifications.

1.02 RELATED WORK

- A. Related Division 27 Sections include:
 - Section 27 05 00 General Communications Requirements 1.
 - Section 27 05 28 Pathways for Communications Systems 2.
 - Section 27 05 29 Hangers and Supports for Communications Systems 3.
 - Section 27 05 33 Raceway and Boxes for Communications Systems 4.
- Related sections in other Divisions of Work: Β.
 - 1. Section 08 71 00 "Door Hardware" for magnetic door holders that release in response to fire-alarm outputs.
 - Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" 2.
- Section Includes: C.
 - 1. Addressable fire-alarm system.
 - Fire Alarm Control Unit/Fire Alarm Control Panel (FACU/FACP). 2.
 - Manual fire-alarm boxes. 3.
 - System smoke detectors. 4.
 - Duct smoke detectors. 5.
 - Heat detectors. 6.
 - 7. Fire-alarm notification appliances.
 - 8. Fire-alarm remote annunciators.
 - 9. Fire-alarm addressable interface devices.
 - 10. Digital alarm communicator transmitters (DACTs).
- D. Related Requirements:
 - Section 08 71 00 "Door Hardware" for magnetic door holders that release in response to 1. fire-alarm outputs.
 - Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" 2.

1.03 REFERENCES AND STANDARDS

- A. Design, cable and component selection, and installation practices shall conform with following:
 - 2021 Oregon Electrical Specialty Code (OESC aka NFPA70 and NEC as adopted by 1. the State of Oregon)
 - 2. 2022 Oregon Structural Specialty Code (OSSC)
 - 2022 Oregon Fire Code (OFC) 3.
 - 2022 Oregon Mechanical Specialty Code (OMSC) 4.
 - 5. Country, State, County, City, and local health, safety and building codes

6. 2022 NFPA 72 – National Fire Alarm and Signaling Code

1.04 DEFINITIONS

- A. DACT: Digital alarm communicator transmitter.
- B. EMT: Electrical metallic tubing.
- C. FACU: Fire Alarm control unit (aka FACP)
- D. FACP: Fire Alarm Control Panel (aka FACU).
- E. High-Performance Building: A building that integrates and optimizes on a life-cycle basis all major high-performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.
- F. Initiating Device: A system component that originates transmission of a signal indicating a change-of-state condition.
- G. IDC: Initiating Device Circuit. A circuit to which automatic or manual initiating devices are connected where the signal received does not identify the individual device operated. Typically uses an end of line resistor to monitor the status of the circuit.
- H. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the 2007 Energy Independence and Security Act (EISA).
- I. Notification Appliance: A fire alarm system component such as a bell, horn, loudspeaker, visual notification appliance, or text display that provides audible, tactile, or visual outputs, or any combination thereof.
- J. NAC: Notification Appliance Circuit. A circuit or path directly connected to a notification appliance(s). Typically uses an end of line resistor to monitor the status of the circuit.
- K. NICET: National Institute for Certification in Engineering Technologies.
- L. PC: Personal computer.
- M. SLC: Signaling Line Circuit. A circuit path between any combination of addressable appliances or devices, circuit interfaces, control units, or transmitters over which multiple system input signals or output signals or both are carried. Typically, the control panel polls devices on the circuit to determine the status (in alarm, in trouble, needs cleaning, out of adjustment, etc.).
- N. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:
 - 1. Control Voltage: Listed and labeled for use in remote-control, signaling, and power-limited circuits supplied by a Class 2 or Class 3 power supply having rated output not greater than 150 V and 5 A, allowing use of alternate wiring methods complying with NFPA 70, Article 725.
 - 2. Low Voltage: Listed and labeled for use in circuits supplied by a Class 1 or other power supply having rated output not greater than 1000 V, requiring use of wiring methods complying with NFPA 70, Article 300, Part I.

1.05 ACTION SUBMITTALS

- A. Approved Permit Submittal: Submittals must be approved by authorities having jurisdiction prior to submitting them to Architect and Engineer.
- B. Product Data: For each type of product, including furnished options and accessories.
 - 1. Include construction details, material descriptions, dimensions, profiles, and finishes.
 - 2. Include rated capacities, operating characteristics, and electrical characteristics.
 - 3. Manufacturer cut sheets depicting more than one product and or options/configurations shall indicate which product and option(s) are being submitted.
- C. Shop Drawings: For fire-alarm system.
 - 1. Comply with recommendations and requirements in NFPA 72, "Documentation" chapter 7, Section 7.4 Shop Drawings.
 - 2. In addition to NFPA 72, 7.4, drawings and documentation shall include: a. details of attachments to other Work.

- b. details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations.
- c. ceiling heights and type such as lay-in tile, grid pattern, and areas that are not accessible.
- d. HVAC air handling grille locations.
- e. HVAC unit designations per construction documents.
- f. Indication of control zones and label dampers per zone and associated air handler.
- g. conductor sizes, termination locations, and distinguish between factory and field wiring.
- h. Conduit fill calculations at all worst-case location of each conduit run.
- i. Annunciator panel details as required by authorities having jurisdiction.
- j. detail assembly and support requirements.
- k. voltage drop calculations for notification-appliance and relay/control circuits.
- I. battery-size calculations.
- m. detailed input/output matrix that includes all HVAC zones and associated dampers.
- n. written statement from manufacturer that submitted equipment and components have been tested as a system and comply with requirements in this Section and in NFPA 72.
- o. performance parameters and installation details for each detector.
- p. verification that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
- q. control wiring diagrams for fire-alarm interface to HVAC; coordinate location of duct smoke detectors and access to them with all trades.
- r. field wiring and equipment required for HVAC unit shutdown and damper control per control sequences in construction documentation.
- s. location of all door lock over-ride controls and components.
- 3. Indicate boundary and label all smoke compartments, fire areas, fire/smoke rated walls and partitions per architectural construction documents.
- D. Delegated Design Submittal: In addition to submittals and shop drawing requirements listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1.06 INFORMATIONAL SUBMITTALS

- A. Certificates:
 - 1. Seismic Performance Certificates: For FACU, accessories, and components, from manufacturer. Include the following information:
 - a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - c. Detailed description of equipment anchorage devices on which certification is based and their installation requirements.
- B. Field quality-control reports.
- C. Qualification Statements: For Installer.
- D. Sample Warranty: Submittal must include line-item pricing for replacement parts and labor.

1.07 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 01 78 23 "Operation and Maintenance Data," include the following:
 - a. Updated shop drawings and calculations as required above reflecting all changes and additions to system up to final AHJ acceptance.

- 1) One hard copy shall be located at the FACP in an approved document enclosure.
- 2) Two (2) hard copies shall be provided to owner.
- 3) One electronic copy each of PDF format and Revit version 2021 shall be provided to Engineer of record and to owner on USB media.
- b. Comply with "Completion Documentation", "Inspection, Testing, and Maintenance Documentation", and "Records, Record Retention, and Record Maintenance" sections of Chapter 7, "Documentation" in NFPA 72.
- c. Provide Record of Completion Documents in accordance with Chapter 7, "Documentation" in NFPA 72.
- d. Record copy of site-specific software.
- e. Provide "Inspection and Testing Form" in accordance with Chapter 7, "Documentation" 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.
- f. Manufacturer's required maintenance related to system warranty requirements.
- g. Abbreviated operating instructions for mounting at FACU and each annunciator unit.

1.08 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Material: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
 - 2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
 - 3. Smoke Detectors, Heat Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
 - 4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than one unit of each type.
 - 5. Keys and Tools: One extra set for access to locked or tamper proofed components.
 - 6. Audible/Visual Notification Appliances, and manual pull stations: one of each type installed.
 - 7. Fuses: Two of each type installed in system. Provide in box or cabinet with compartments marked with fuse types and sizes.

1.09 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Registration, licensing, or certification by a state or local authority.
 - 2. Must be certified by NICET as fire-alarm Level II.
 - 3. Licensed or certified by authorities having jurisdiction.
- B. Designer Qualifications:
 - 1. Must be certified by NICET as fire-alarm Level III.
 - 2. Plans and specifications shall be developed in accordance with NFPA72 by persons who are experienced in the design, application, installation, and testing of the systems.
 - 3. Credentialed as required by the State of Oregon.
 - 4. State and local licensure regulations shall be followed to determine qualified personnel.
 - 5. System design trainees shall be under the supervision of a qualified system designer.

1.10 FIELD CONDITIONS

A. Seismic Conditions: Unless otherwise indicated on Contract Documents, specified Work in this Section must withstand the seismic hazard design loads determined in accordance with ASCE/SEI 7 for installed elevation above or below grade.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail because of defects in materials or workmanship within specified warranty period.
 - 1. Warranty Period: One year from date of written acceptance by AHJ.
 - 2. Upon notification of a problem, the warranty provider shall furnish within 48 hours, at no cost to the Owner, such labor and materials as are needed to restore the system to proper operation.
 - 3. During the entire 1 year warranty period the Contractor shall provide all related software upgrades to the installed system(s). Following the initial 1 year warranty period, any software changes and/or updates that impact the life safety and/or panel function shall be provided at no additional cost to the Owner for 3 additional years.
 - 4. At end of the 1 year warranty period, with owner present, the Contractor shall conduct a 1 year test and inspection as required by NFPA-72 and provide a report of system equipment and system operational functions.

PART 2 PRODUCTS

2.

2.01 FIRE ALARM SYSTEM

- A. Approved manufacturers are:
 - 1. FACU/FACP
 - a. Silent Knight
 - b. Potter
 - c. Other manufacturers pre-approved prior to bid
 - Notification Devices:
 - a. System Sensor
 - b. Other manufacturers pre-approved prior to bid
- B. Devices connected to the control and or extension panels shall be UL listed for use with the panel or control equipment they are connected to.
- C. All control equipment and devices shall be UL listed for the environment in which it is being installed.

2.02 ADDRESSABLE FIRE ALARM SYSTEM

- A. Description:
 - 1. Analog, Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn-and-strobe notification for a total evacuation system.
- B. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. Fire-Alarm Components, Devices, and Accessories: Listed and labeled by a NRTL in accordance with NFPA 70 and NFPA 72 for use with selected fire-alarm system and marked for intended location and application.
 - 2. General Characteristics:
 - a. Automatic sensitivity control of certain smoke detectors.
 - b. "Alarm" signal initiation shall be by one or more of the following devices and systems:
 - 1) Manual stations.
 - 2) Heat detectors.
 - 3) Smoke detectors.
 - 4) Duct smoke detectors.
 - 5) Automatic Fire Sprinkler system water flow.
 - 6) Pre-action Fire Sprinkler System water pressure switch.
 - 7) Monitored Dedicated Function Fire Alarm System transmits Alarm.
 - 8) Elevator recall and supervisory system.
 - c. Alarm signal must initiate the following actions:
 - 1) Identify alarm and specific initiating device at FACU/FACP and remote annunciators.
 - 2) Transmit alarm signal to remote central station.

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- 3) Over-ride electric door locks in designated egress paths or provide written variance from AHJ allowing the door to remain locked.
- 4) Release all fire and smoke doors held open by magnetic door holders.
- 5) Activate notification devices.
- 6) Shut down all Air Handlers and close associated smoke/firesmoke
- 7) Allow pre-action system pipes to go wet upon activation of pre-action manual pull station or cross zoned detector alarm verification.
- 8) Upon alarm from associated smoke detector in elevator lobby, elevator shaft, or elevator machine room, recall elevators to primary or alternate recall floors as directed by AHJ. FACP initiates an Alarm signal and activates building notification devices.
- 9) Upon alarm from associated heat detector, activate elevator power shunt trip.
- 10) Upon alarm from associated smoke detector in elevator shaft, activate elevator cab notification (Fireman's Hat).
- 11) Record events in system memory.
- d. Supervisory signal initiation must be by one or more of the following devices and actions:
 - 1) Duct Smoke Detector.
 - 2) Fire Sprinkler Valve Tamper Switch.
 - 3) Fire Sprinkler DCA (backflow preventer) Tamper Switch in vault.
 - 4) High- or low-air-pressure switch of dry-pipe or pre-action sprinkler system.
 - 5) Loss of Elevator shunt-trip power.
 - 6) Monitored Dedicated Function Fire Alarm System transmits Supervisory.
 - 7) Zones or individual devices have been disabled.
- e. System trouble signal initiation must 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 signalinitiating devices.
 - 3) Loss of communication with addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
 - 4) Loss of primary power at FACU.
 - 5) Ground or single break in internal circuits of FACU.
 - 6) Abnormal ac voltage at FACU.
 - 7) Break in standby battery circuitry.
 - 8) Failure of battery charging.
 - 9) Abnormal position of switch at FACU or annunciator that impairs system.
- f. System Supervisory and Trouble Signal Actions:
 - 1) Identify specific device initiating event at FACU/FACP, and remote annunciators.
 - 2) Transmit signal to remote central station.
- g. Provide Document Storage Box at the FACP location:
 - 1) Description: Enclosure to accommodate record drawings and operational manuals. and loose document records.
 - 2) Material and Finish: 18-gauge cold-rolled steel; four mounting holes.
 - 3) Color: Red powder-coat epoxy finish.
 - 4) Labeling: Permanently screened with 1-inch high lettering "S STEM RECORD DOCUMENTS" with white indelible ink.
 - 5) Security: Key Lock shall match system keys.

2.03 FIRE ALARM CONTROL UNIT FACU FACP

- A. Description: Field-programmable, microprocessor-based, modular, power-limited design with electronic modules.
- B. Performance Criteria:
 - 1. Regulatory Requirements: Comply with NFPA 72 and UL 864.
 - 2. General Characteristics:

- a. System software and programs must be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining information through failure of primary and secondary power supplies.
- b. Include real-time clock for time annotation of events on event recorder and printer.
- c. Provide communication between FACU and remote circuit interface panels, annunciators, and displays.
- d. FACU must be listed for connection to central-station signaling system service.
- e. FACU must be listed for releasing service if separate control panel is not provided for pre-action and or clean-agent systems.
- f. Provide nonvolatile memory for system database, logic, and operating system and event history. System must require no manual input to initialize in the event of complete power down condition. FACU must provide minimum 500-event history log.
- g. Addressable Initiation Device Circuits: FACU must indicate which communication zones have been silenced and must provide selective silencing of alarm notification appliance by building communication zone.
 - 1) Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: FACU must be listed for releasing service.
- h. Alphanumeric Display and System Controls: Arranged for interface between human operator at FACU and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and programming and control menu.
 - 1) Annunciator and Display: LCD, 80 characters, minimum.
 - 2) Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into system for control of smoke-detector sensitivity and other parameters.
- i. Serial Interfaces:
 - 1) As required for central-station communication.
 - 2) One USB port for PC configuration.
- j. Notification-Appliance Circuit:
 - 1) Audible appliances must sound in three-pulse temporal pattern, as defined in NFPA 72.
 - 2) Where notification appliances provide signals to sleeping areas, alarm signal must be 520 Hz square wave with intensity 15 dB above average ambient sound level or 5 dB above maximum sound level, or at least 75 dB(A-weighted), whichever is greater, measured at pillow.
 - 3) Visual alarm appliances must flash in synchronization where multiple appliances are in same field of view, as defined in NFPA 72.
- k. Elevator Recall: Initiate by one of the following alarm-initiating devices:
 - 1) Elevator lobby detectors except lobby detector on designated floor.
 - 2) Smoke detectors in elevator hoistway.
- I. Elevator controller must be programmed to move cars to alternate recall floor if lobby detectors located on designated recall floors are activated.
- m. Water-flow alarm connected to sprinkler in elevator shaft must shut down elevators associated with location without time delay.
 - 1) Water-flow switch associated with sprinkler in elevator pit may have delay to allow elevators to move to designated floor.
- n. Door Controls: At least one NAC Output circuit shall be capable of being configured as a Door hold-open circuit unless NAC power extender panels included in the system has this capability. Smoke detectors integral to door frame or door hardware shall not be allowed.
- o. Remote Smoke-Detector Sensitivity Adjustment: Controls must select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory.

- p. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to remote alarm station.
- q. Primary Power: 24 V(dc) obtained from 120 V(ac) service and power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, and supervisory signals must be powered by 24 V(dc) source.
- r. Alarm current draw of entire fire-alarm system must not exceed 80 percent of powersupply module rating.
- s. Secondary Power: 24 V(dc) supply system with batteries, automatic battery charger, and automatic transfer switch.
- t. Batteries: Sealed, valve-regulated, recombinant lead acid.
- C. Accessories:
 - 1. Instructions: Computer printout or typewritten instruction card mounted behind plastic or glass cover in stainless steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe functional operation of system under normal, alarm, and trouble conditions.
 - 2. Preaction System Functionality:
 - a. Initiate Presignal Alarm: This function must cause audible and visual alarm and indication to be provided at FACU. Activation of initiation device connected as part of preaction system must be annunciated at FACU only, without activation of general evacuation alarm.

2.04 MANUAL FIRE ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes must be finished in red with molded, raised-letter operating instructions in contrasting color; must show visible indication of operation; and must be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
 - 1. Single-action mechanism, breaking-glass type not allowed; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to FACU.
 - 2. Station Reset: Key matching system key.
 - 3. Able to perform at up to 90 percent relative humidity at 90 deg F.

2.05 SYSTEM SMOKE DETECTORS

- A. Photoelectric Smoke Detectors:
 - 1. Performance Criteria:
 - a. Regulatory Requirements:
 - 1) NFPA 72.
 - 2) UL 268.
 - b. General Characteristics:
 - 1) Detectors must be two-wire type.
 - 2) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
 - Base Mounting: Detector and associated electronic components must be mounted in twist-lock module that connects to fixed base. Provide terminals in fixed base for connection to building wiring.
 - 4) Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 - 5) Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
 - 6) Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
 - 7) Operator at FACU, having designated access level, must 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.).
- 8) Detector must have functional humidity range within 10 to 90 percent relative humidity.
- 9) Color: White.
- 10) Remote Control: Unless otherwise indicated, detectors must be digitaladdressable type, individually monitored at FACU for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by FACU.
- 11) Multiple levels of detection sensitivity for each sensor.
- 12) Sensitivity levels based on time of day.
- B. Ionization Smoke Detectors:
 - 1. Not allowed without prior approval.

2.06 DUCT SMOKE DETECTORS

- A. Description: Photoelectric-type, duct-mounted smoke detector.
- B. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. NFPÁ 72.
 - b. UL 268A.
 - 2. General Characteristics:
 - a. Detectors must be two-wire type.
 - b. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
 - c. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 - d. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
 - e. Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
 - f. Operator at FACU, having designated access level, must be able to manually access the following for each detector:
 - 1) Primary status.
 - 2) Device type.
 - 3) Present average value.
 - 4) Present sensitivity selected.
 - 5) Sensor range (normal, dirty, etc.).
 - g. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4 ; NRTL listed for use with supplied detector for smoke detection in HVAC system ducts.
 - h. Each sensor must have multiple levels of detection sensitivity.
 - i. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
 - j. Relay Fan Shutdown: Provide relay circuit to interrupt fan motor-control circuit. Detector shall not have an integral relay without prior approval.
 - k. Provide remote test switch and status indicator located in nearest visible occupiable area on proximity to the duct mounted smoke detector location.

2.07 HEAT DETECTORS

- A. Combination-Type Heat Detectors:
 - 1. Shall not be used for elevator shunt trip
 - 2. Performance Criteria:
 - a. Regulatory Requirements:
 - 1) NFPA 72.
 - 2) UL 521.
 - b. General Characteristics:
 - 1) Temperature sensors must test for and communicate sensitivity range of device.

- c. Actuated by fixed temperature of 135 deg F or rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
- d. Mounting: Twist-lock base interchangeable with smoke-detector bases.
- e. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
- f. Detector must have functional humidity range of 10 to 90 percent relative humidity.
- g. Color: White.
- B. Fixed-Temperature-Type Heat Detectors:
 - 1. Performance Criteria:
 - a. Regulatory Requirements:
 - 1) NFPA 72.
 - 2) UL 521.
 - b. General Characteristics:
 - Actuated by temperature that exceeds fixed temperature of 135 deg F for typical installations, and 190 deg F for high temperature locations such as attics or other locations subject to unwanted alarms due to environmental conditions. When the heat detector must alarm prior to an associated sprinkler head, the fixed temperature point shall be lower than the fire sprinkler-head bulb melting point.
 - 2) Mounting: Twist-lock base interchangeable with smoke-detector bases.
 - 3) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
 - 4) Detector must have functional humidity range of 10 to 90 percent.
 - 5) Color: White.

2.08 FIRE ALARM NOTIFICATION APPLIANCES

- A. Fire-Alarm Audible Notification Appliances:
 - 1. Description: Horns (interior), and fire sprinkler bell exterior, that cannot output voice messages.
 - 2. Performance Criteria:
 - a. Regulatory Requirements:
 - 1) NFPA 72.
 - b. General Characteristics:
 - 1) Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
 - 2) Audible notification appliances must have functional humidity range of 10 to 95 percent relative humidity.
 - 3) Horns: Electric-vibrating-polarized type, 24 V(dc); with provision for housing operating mechanism behind grille. Comply with UL 464. Horns must produce sound-pressure level of 90 dB(A-weighted), measured 10 ft. from horn, using coded signal prescribed in UL 464 test protocol.
 - 4) Combination Devices: Factory-integrated audible and visible devices in singlemounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.
- B. Fire-Alarm Visible Notification Appliances:
 - 1. Performance Criteria:
 - a. Regulatory Requirements:
 - 1) NFPA 72.
 - 2) UL 1971.
 - b. General Characteristics:
 - 1) Rated Light Output:
 - a) 15 to 185cd with field selectable standard increments.
 - b) Candela range may be provided by a separate low/standard output range device and a high intensity output upper range device.
 - 2) Clear or nominal white polycarbonate lens mounted on aluminum faceplate.

- 3) Mounting: Wall mounted unless otherwise indicated.
- 4) Flashing must be in temporal pattern, synchronized with all other units regardless if units are viewable simultaneously or not.
- 5) Strobe Leads: Factory connected to screw terminals.
- 6) Mounting Faceplate: Factory finished, red or white as approved by Architect and Owner.

2.09 FIRE ALARM REMOTE ANNUNCIATORS

A. Performance Criteria:

1.

- Regulatory Requirements:
- a. NFPA 72.
- 2. General Characteristics:
 - a. Annunciator functions must match those of FACU for alarm, supervisory, and trouble indications. Manual switching functions must match those of FACU, including acknowledging, silencing, resetting, and testing.
 - 1) Mounting: Flush or surface cabinet as approved by Architect, NEMA 250, Type 1.
 - b. Display Type and Functional Performance: Alphanumeric display and LED indicating lights must match those of FACU, 80 character minimum. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.10 FIRE ALARM ADDRESSABLE INTERFACE DEVICES

- A. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. NFPA 72.
 - 2. General Characteristics:
 - a. Include address-setting means on module.
 - b. Store internal identifying code for control panel use to identify module type.
 - c. Listed for controlling HVAC fan motor controllers.
 - d. Monitor Module: Microelectronic module providing system address for alarm-initiating devices for wired applications with normally open contacts.
 - e. Integral Relay: Capable of providing direct signal to elevator controller to initiate elevator recall, and to circuit-breaker shunt trip for power shutdown.
 - 1) Allow control panel to switch relay contacts on command.
 - 2) Have minimum of two normally open and two normally closed contacts available for field wiring.
 - f. Control Module:
 - 1) Operate notification devices.
 - 2) Operate solenoids for use in sprinkler service.

2.11 DIGITAL ALARM COMMUNICATOR TRANSMITTERS DACTS

- A. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. NFPÁ 72.
 - 2. General Characteristics:
 - a. DACT must be acceptable to remote central station and must be listed for fire-alarm use.
 - b. Functional Performance: Unit must receive detailed alarm, supervisory, or trouble signal from FACU, including device type, device address, and device location, and automatically capture two pathways of communication to remote central station per NFPA-72 requirements. When contact is made with central station(s), signals must be transmitted. If service on either line is interrupted per conditions detailed in NFPA-72, transmitter must initiate local trouble signal and transmit signal indicating loss of communication to remote alarm receiving station over remaining line. Transmitter must automatically report communication service restoration to central station. If

service is lost on both communication lines, transmitter must initiate local trouble signal per NFPA-72.

- c. Local functions and display at DACT must include the following:
 - 1) Verification that communication lines are available to central station.
 - 2) Programming device.
 - 3) LED display.
 - 4) Manual test report function and manual transmission clear indication.
 - 5) Communications failure with central station or FACU.
- d. Digital data transmission must include the following:
 - 1) Address of alarm-initiating device.
 - 2) Address of supervisory signal.
 - 3) Address of trouble-initiating device.
 - 4) Loss of ac supply.
 - 5) Loss of power.
 - 6) Low battery.
 - 7) Abnormal test signal.
 - 8) Communication bus failure.
- e. Secondary Power: Integral rechargeable battery and automatic charger if DACT and media conversion devices are not integral to FACU/FACP.
- f. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
 - 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protection of In-Place Conditions: Protect devices during construction unless devices are placed in service to protect facility during construction.

3.03 INSTALLATION OF EQUIPMENT

- A. Comply with NECA 305, NFPA 72, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
 - 1. Devices placed in service before other trades have completed cleanup must be replaced.
 - 2. Devices installed, but not yet placed, in service must be protected from construction dust, debris, dirt, moisture, and damage in accordance with manufacturer's written storage instructions.
 - 3. Install seismic bracing. Comply with requirements in Section 26 05 48 "Seismic Controls for Electrical Systems."
 - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18 inchcenters around full perimeter of concrete base.
 - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 7. Install anchor bolts to elevations required for proper attachment to supported equipment.

- B. Equipment Wall Mounting:
 - 1. Comply with requirements for seismic-restraint devices specified in Section 26 05 48 "Seismic Controls for Electrical Systems."
- C. Install wall-mounted equipment, with tops of cabinets not more than 78 inchabove finished floor.
 - 1. Comply with requirements for seismic-restraint devices specified in Section 26 05 48 "Seismic Controls for Electrical Systems."
- D. Manual Fire-Alarm Boxes:
 - 1. Install manual fire-alarm box in normal path of egress within 60 inchof exit doorway.
 - 2. Mount manual fire-alarm box on background of contrasting color.
 - 3. Operable part of manual fire-alarm box must be between 42 and 48 inchabove floor level. Devices must be mounted at same height unless otherwise indicated.
- E. Smoke- and Heat-Detector Spacing:
 - 1. Comply with "Smoke-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
 - 2. Comply with "Heat-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
 - 3. Smooth ceiling spacing must not exceed 30 ft. or include required coverage are within a 21-foot radius circle.
 - 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas must be determined in accordance with Annex A in NFPA 72.
 - 5. HVAC: Locate detectors not closer than 36 inches from air-supply, air return, and air exhaust diffuser openings.
 - 6. Lighting Fixtures: Locate detectors not closer than 12 inchesfrom lighting fixture and not directly above pendant mounted or indirect lighting.
- F. Install cover on each smoke detector that is not placed in service during construction. Cover must remain in place except during system testing. Remove cover prior to system turnover.
- G. Duct Smoke Detectors: Comply with NFPA 72 and the Oregon Mechanical Specialty Code. Install sampling tubes so they extend full width of duct. Tubes more than 36 inchlong must be supported at both ends.
 - 1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.
- H. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.
- I. Remote Status and Alarm Indicators: Install in visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.
- J. Audible, visual, and combination audible-visual Alarm-Indicating Devices: Install on flushmounted back boxes with audible portion of device-operating mechanism concealed behind grille. Install devices at same height unless otherwise indicated. Refer to device mounting details on drawings. Coordinate final device height with Architectural contract documents prior to rough-in. Report any device mounting heights that do not comply with governing codes and standards to Architect and Engineer of Record.
- K. Device Location-Indicating Lights: Locate in visible public space near device they monitor.

3.04 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70, OESC, and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate must be laminated acrylic or melamine plastic signs, as specified in Section 26 05 53 "Identification for Electrical Systems."

3.05 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Install nameplate for each control connection, indicating field control panel designation and I/O control designation feeding connection.

3.06 PATHWAYS

- A. Pathways must be installed in EMT.
- B. Exposed EMT must be provided as or painted red enamel.

3.07 CIRCUITS

- A. Circuit Class:
 - 1. IDC (Initiating Device Circuits):
 - a. Pathway NFPA 72 Class Designation: Class B.
 - 2. SLC (Signaling Line Circuits):
 - a. Pathway NFPA 72 Class Designation: Class A or B.
 - 3. NAC (Notification Appliance Circuits):
 - a. Pathway NFPA 72 Class Designation: Class B.
 - DACT (Digital Alarm Communicator Transmitter) circuit:
 a. Pathway NFPA 72 Class Designation: Class C or N as applicable.
 - 5. Emergency Control Function Interfaces (Door Hold-open release, HVAC shutdown, Elevator Recall, etc.):
 - a. Control circuit between Interface device and the equipment being controlled: Pathway NFPA 72 Class Designation: Class D (Failsafe).
- B. Pathway Survivability
 - 1. Pathway Survivability levels shall be designated for each type of circuit as required by NFPA-72 and other governing codes. Levels shall be classified as defined in NFPA-72 as follows: Level 0, Level 1, Level 2, or Level 3.
 - a. All pathways shall comply with the governing version of the Oregon Electrical Specialty Code.
 - b. SLC circuits: Level 0
 - c. IDC circuits: Level 0
 - d. NAC circuits: Level 0
 - e. Emergency Control Function Interface circuits: Level 0
- C. Zones
 - 1. Install additional fault circuit isolators to comply with circuit performance and protection requirements of NFPA 72 and comply with manufacturer's written instructions. At a minimum:
 - a. A single fault shall not disable devices in more than one SLC zone.
 - b. Each zone shall be protected with circuit isolators.
 - c. Each floor of the building shall be considered a separate zone and further divided into zones by smoke compartments of maximum allowable square footage as required by the Oregon Fire Code, Oregon Structural Specialty Code, and NFPA-72.
 - d. Do not exceed the maximum number of devices allowed between isolators as recommended by the manufacturer.
 - e. The FACP shall be protected using circuit isolators unless isolators are integral to the FACP.

3.08 CONNECTIONS

- A. Smoke detectors integral to door frame or hardware shall not be allowed.
- B. Make addressable connections with supervised interface device to the following devices and systems:
 - 1. Smoke dampers in air ducts of designated HVAC duct systems.

- 2. Air handling fans of designated HVAC units.
- 3. Magnetically held-open doors.
- 4. Electronically locked doors and access gates.
- 5. Alarm-initiating connection to elevator recall system and components.
- 6. Supervisory connections at valve supervisory switches.
- 7. Supervisory connections at low-air-pressure switch of each dry-pipe or pre-action sprinkler system.
- 8. Supervisory connections at elevator shunt-trip breaker.

3.09 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- B. Install framed instructions in location visible from FACU/FACP.

3.10 GROUNDING

- A. Ground FACU and associated circuits in accordance with Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- B. Ground shielded cables at control panel location only. Insulate shield at device location.

3.11 FIELD QUALITY CONTROL

- A. Field tests must be witnessed by Owner and authorities having jurisdiction.
- B. Administrant for Tests and Inspections:
 - 1. Administer and perform tests and inspections with assistance of factory-authorized service representative.
- C. Tests and Inspections:
 - 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection must be based on completed record Drawings and system documentation that is required by "Completion Documents, Preparation" table in "Documentation" section of "Fundamentals" chapter in NFPA 72.
 - b. Comply with "Visual Inspection Frequencies" table in "Inspection" section of "Inspection, Testing and Maintenance" chapter in NFPA 72; retain "Initial/Reacceptance" column and list only installed components.
 - 2. System Testing: Comply with "Test Methods" table in "Testing" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 3. Factory-authorized service representative must prepare "Fire Alarm System Record of Completion" in "Documentation" section of "Fundamentals" chapter in NFPA 72 and "Inspection and Testing Form" in "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
- D. Reacceptance Testing: Perform reacceptance testing to verify proper operation of added or replaced devices and appliances.
- E. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.12 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system. Allow Owner to record training.
- B. Allow a minimum of 4 people designated by owner to attend training.
- C. Training shall be a minimum of 4 hours.

3.13 MAINTENANCE

- A. Maintenance Service: Beginning at Completion sign-off of acceptance by AHJ, maintenance service must include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies must be manufacturer's authorized replacement parts and supplies.
 - 1. Include visual inspections in accordance with "Visual Inspection Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 2. Perform tests in "Test Methods" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 3. Perform tests per "Testing Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.

END OF SECTION 28 3100

SECTION 31 10 00 SITE CLEARING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Clearing and protection of vegetation.
- B. Removal of existing debris.

1.02 RELATED REQUIREMENTS

- A. Section 01 50 00 Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- B. Section 01 57 13 Temporary Erosion and Sediment Control.
- C. Section 01 70 00 Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products.
- D. Section 01 74 19 Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- E. Section 31 22 00 Grading: Topsoil removal.
- F. Section 31 22 00 Grading: Fill material for filling holes, pits, and excavations generated as a result of removal operations.
- G. Section 31 23 23 Fill: Filling holes, pits, and excavations generated as a result of removal operations.
- H. Section 32 93 00 Plants: Relocation of existing trees, shrubs, and other plants.
- I. Section 32 93 00 Plants: Pruning of existing trees to remain.
- J. Reference: Project Geotechnical Design Report as prepared by The Galli Group.

1.03 PROJECT CONDITIONS

A. Minimize production of dust due to clearing operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

PART 2 PRODUCTS

2.01 MATERIALS

A. As specified in Section 31 23 23 - Fill and Backfill

PART 3 EXECUTION

3.01 SITE CLEARING

- A. Comply with other requirements specified in Section 01 70 00.
- B. Minimize production of dust due to clearing operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

3.02 EXISTING UTILITIES AND BUILT ELEMENTS

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Protect existing structures and other elements that are not to be removed.

3.03 VEGETATION

- A. Scope: Remove trees, shrubs, brush, and stumps in areas to be covered by building structure, paving, playing fields, lawns, and planting beds.
- B. Do not begin clearing until vegetation to be relocated has been removed.
- C. Do not remove or damage vegetation beyond the limits indicated on drawings.
 - 1. Exception: Specific trees and vegetation indicated on drawings to be removed.

- D. Install substantial, highly visible fences at least 4 feet high to prevent inadvertent damage to vegetation to remain:
 - 1. At vegetation removal limits.
 - 2. Around trees to remain within vegetation removal limits; locate no closer to tree than at the drip line.
 - 3. Around other vegetation to remain within vegetation removal limits.
- E. In areas where vegetation must be removed but no construction will occur other than pervious paving, remove vegetation with minimum disturbance of the subsoil.
- F. Vegetation Removed: Do not burn, bury, landfill, or leave on site, except as indicated.
 - 1. Chip, grind, crush, or shred vegetation for mulching, composting, or other purposes; preference should be given to on-site uses.
 - 2. Trees: Sell if marketable; if not, treat as specified for other vegetation removed; remove stumps and roots to depth of 24 inches.
 - 3. Sod: Re-use on site if possible; otherwise sell if marketable, and if not, treat as specified for other vegetation removed.
- G. Restoration: If vegetation outside removal limits or within specified protective fences is damaged or destroyed due to subsequent construction operations, replace at no cost to Owner. Coordinate any such work with Landscape Architect prior to construction.

3.04 DEBRIS

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 31 22 00 GRADING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Rough grading the site for parking lots, site structures, building pads, retaining walls, and other necessary items.
- B. Finish grading.

1.02 RELATED REQUIREMENTS

- A. Section 31 10 00 Site Clearing.
- B. Section 31 23 16 Excavation.
- C. Section 31 23 16.13 Trenching: Trenching and backfilling for utilities.
- D. Section 31 23 23 Fill: Filling and compaction.
- E. Reference: Project Geotechnical Design Report as prepared by The Galli Group.

1.03 SUBMITTALS

A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with State of Oregon, Highway Department standards.

1.05 PROJECT CONDITIONS

- A. Protect above- and below-grade utilities that remain.
- B. Protect plants, lawns, and other features to remain as a portion of final landscaping.
- C. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from grading equipment and vehicular traffic.

PART 2 - PRODUCTS

2.01 MATERIALS

A. As specified in Section 31 23 23 - Fill.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.
- B. Verify the absence of standing or ponding water.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Stake and flag locations of known utilities.
- C. Locate, identify, and protect from damage above- and below-grade utilities to remain.
- D. Notify utility company to remove and relocate utilities.
- E. Provide temporary means and methods to remove all standing or ponding water from areas prior to grading.

3.03 ROUGH GRADING

- A. Remove topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.
- B. Do not remove topsoil when wet.
- C. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.
- D. Do not remove wet subsoil, unless it is subsequently processed to obtain optimum moisture content.
- E. When excavating through roots, perform work by hand and cut roots with sharp axe.
- F. Benching Slopes: Horizontally bench existing slopes greater than 1:4 to key fill material to slope for firm bearing.
- G. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.
- H. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack surface water control.

3.04 SOIL REMOVAL

- A. Stockpile topsoil to be re-used on site; remove remainder from site.
- B. Stockpile subsoil to be re-used on site; remove remainder from site.
- C. Stockpiles: Contractor shall be responsible for identifying and coordinating stockpile locations on site with the project plans; pile depth not to exceed 12 feet; protect from erosion. Coordinate with Owner and Engineer at time of construction as required.

3.05 FINISH GRADING

- A. Before Finish Grading:
 - 1. Verify building and trench backfilling have been inspected.
 - 2. Verify subgrade has been contoured and compacted.
- B. Remove debris, roots, branches, stones, in excess of 1/2 inch in size. Remove soil contaminated with petroleum products.
- C. Where topsoil is to be placed, scarify surface to depth of 3 inches.
- D. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 3 inches.
- E. Place topsoil in areas indicated Refer to Landscape Plans as required.
- F. Place topsoil where required to level finish grade.
- G. Place topsoil to thickness as scheduled Refer to Landscape Plans as required.
- H. Place topsoil during dry weather.
- I. Remove roots, weeds, rocks, and foreign material while spreading.
- J. Near plants spread topsoil manually to prevent damage.
- K. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.
- L. Lightly compact placed topsoil.
- M. Maintain stability of topsoil during inclement weather. Replace topsoil in areas where surface water has eroded thickness below specifications.

3.06 CLEANING

- A. Remove unused stockpiled topsoil and subsoil. Grade stockpile area to prevent standing water.
- B. Leave site clean and raked, ready to receive landscaping.

SECTION 31 23 16 EXCAVATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Excavating for building volume below grade, footings, slabs-on-grade, paving, site structures, utilities within the building, and retaining walls.
- B. Trenching for utilities outside the building to utility main connections.
- C. Temporary excavation support and protection systems.

1.02 RELATED REQUIREMENTS

- A. Section 01 57 13 Temporary Erosion and Sediment Control: Slope protection and erosion control.
- B. Section 31 22 00 Grading: Soil removal from surface of site.
- C. Section 31 22 00 Grading: Grading.
- D. Section 31 23 16.13 Trenching: Excavating for utility trenches outside the building to utility main connections.
- E. Section 31 23 23 Fill: Fill materials, backfilling, and compacting.
- F. Section 33 41 00 Subdrainage: Filter aggregate and filter fabric for foundation drainage systems.
- G. Reference: Project Geotechnical Design Report as prepared by The Galli Group.

1.03 PROJECT CONDITIONS

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.
- B. Protect plants, lawns, rock outcroppings, and other features to remain.
- C. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the work are as indicated.
- B. Survey existing adjacent structures and improvements and establish exact elevations at fixed points to act as benchmarks.
 - 1. Resurvey benchmarks during installation of excavation support and protection systems and notify Owner if any changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. See Section 31 22 00 for topsoil removal.
- C. Locate, identify, and protect utilities that remain and protect from damage.
- D. Grade top perimeter of excavation to prevent surface water from draining into excavation. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by Engineer.

3.03 TEMPORARY EXCAVATION SUPPORT AND PROTECTION

- A. Excavation Safety: Comply with OSHA's Excavation Standard, 29 CFR 1926, Subpart P.
 - 1. Excavations in stable rock or in less than 5 feet in depth in ground judged as having no cave-in potential do not require excavation support and protection systems.
 - 2. Depending upon excavation depth, time that excavation is open, soil classification, configuration and slope of excavation sidewalls, design and provide an excavation support and protection system that meets the requirements of 29 CFR 1926, Subpart P:
 - a. Sloping and benching systems.

- b. Support systems, shield systems, and other protective systems.
- B. Leave excavation support and protection systems, used as formwork or within 10 feet of existing foundations, permanently in place, unless otherwise noted.
 - 1. Cut off top 4 feet below grade, abandon remainder.
- C. Excavation support and protection systems not required to remain in place may be removed subject to approval of Owner or Owner's Representative.
 - 1. Remove temporary shoring and bracing in a manner to avoid harmful disturbance to underlying soils and damage to buildings, structures, pavements, facilities and utilities.

3.04 EXCAVATING

- A. Excavate to accommodate new structures and construction operations.
- B. Notify Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- C. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
- D. Do not interfere with 45 degree bearing splay of foundations.
- E. Cut utility trenches wide enough to allow inspection of installed utilities.
- F. Hand trim excavations. Remove loose matter.
- G. Correct areas that are over-excavated and load-bearing surfaces that are disturbed; see Section 31 23 23.
- H. Provide temporary means and methods, as required, to remove all water from excavations until directed by Engineer. Remove and replace soils deemed suitable by classification and which are excessively moist due to lack of dewatering or surface water control.
- I. Remove excavated material that is unsuitable for re-use from site.
- J. Stockpile excavated material to be re-used in area designated on site 31 22 00.
- K. Remove excess excavated material from site.

3.05 FIELD QUALITY CONTROL

- A. See Section 01 40 00 Quality Requirements, for general requirements for field inspection and testing.
- B. Provide for visual inspection of load-bearing excavated surfaces by Engineer before placement of foundations.

3.06 PROTECTION

- A. Divert surface flow from rains or water discharges from the excavation.
- B. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.
- C. Protect open excavations from rainfall, runoff, freezing groundwater, or excessive drying so as to maintain foundation subgrade in satisfactory, undisturbed condition.
- D. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- E. Keep excavations free of standing water and completely free of water during concrete placement.

SECTION 31 23 16.13 TRENCHING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Backfilling and compacting for utilities outside the building to existing private utilities on site or utility main connections.

1.02 RELATED REQUIREMENTS

- A. Section 31 22 00 Grading: Site grading.
- B. Section 31 23 16 Excavation: Building and foundation excavating.
- C. Section 31 23 23 Fill: Backfilling at building and foundations.
- D. Section 33 41 00 Subdrainage: Filter aggregate and filter fabric for foundation drainage systems.
- E. Reference: Project Geotechnical Design Report as prepared by The Galli Group.

1.03 REFERENCE STANDARDS

- A. AASHTO T 180 Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; 2010.
- B. ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012.
- C. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN m/m3)); 2012.
- D. ASTM D 2922 Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth); 2005.

1.04 DEFINITIONS

A. Finish Grade Elevations: Indicated on drawings.

1.05 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
- B. Materials Sources: Submit name of imported materials source.
- C. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- D. Compaction Density Test Reports.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. When necessary, store materials on site in advance of need.
- B. Verify that survey bench marks and intended elevations for the Work are as indicated.
- C. Protect plants, lawns, and other features to remain.
- D. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

PART 2 PRODUCTS

2.01 FILL MATERIALS

A. As specified in Section 31 23 23 - Fill.

2.02 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 Quality Requirements, for general requirements for testing and analysis of soil material.
- B. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that survey bench marks and intended elevations for the work are as indicated.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. See Section 31 22 00 for additional requirements.
- C. Locate, identify, and protect utilities that remain and protect from damage.
- D. Grade top perimeter of trenching area to prevent surface water from draining into trench. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by the Engineer.

3.03 TRENCHING

- A. Notify Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- B. Slope banks of excavations deeper than 5 feet to angle of repose or less until shored.
- C. Do not interfere with 45 degree bearing splay of foundations.
- D. Cut trenches wide enough to allow inspection of installed utilities.
- E. Hand trim excavations. Remove loose matter.
- F. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.
- G. Remove lumped subsoil, boulders, and rock up to 1/3 cubic yard measured by volume. See Section 31 23 16.26 for removal of larger material.
- H. Remove excavated material that is unsuitable for re-use from site.
- I. Stockpile excavated material to be re-used in area designated in Section 31 22 00.
- J. Remove excess excavated material from site.
- K. Provide temporary means and methods, as required, to remove all water from trenching until directed by the Engineer. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.
- L. Determine the prevailing groundwater level prior to trenching. If the proposed trench extends less than 1 foot into the prevailing groundwater, control groundwater intrusion with perimeter drains routed to sump pumps, or as directed by the Engineer.

3.04 PREPARATION FOR UTILITY PLACEMENT

- A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with Granular Fill.
- B. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- C. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.

3.05 BACKFILLING

- A. Backfill to contours and elevations indicated using unfrozen materials.
- B. Fill up to subgrade elevations unless otherwise indicated.
- C. Employ a placement method that does not disturb or damage other work.
- D. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Granular Fill: Place and compact materials in equal continuous layers in accordance with the Project Geotechnical Design Report as prepared by The Galli Group.
- G. Soil Fill: Place and compact materials in equal continuous layers in accordance with the Project Geotechnical Design Report as prepared by The Galli Group.

- H. Compaction densities shall be in accordance with the Project Geotechnical Design Report as prepared by The Galli Group.
- I. Slope grade away from building minimum 2 inches in 10 feet, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- J. Correct areas that are over-excavated.
 - 1. Thrust bearing surfaces: Fill with concrete.
 - 2. Other areas: Use structural fill, flush to required elevation, compacted to minimum 95 percent of maximum dry density.
- K. Reshape and re-compact fills subjected to vehicular traffic.

3.06 BEDDING AND FILL AT SPECIFIC LOCATIONS

- A. Utility Piping, Conduits, and Duct Bank:
 - 1. Bedding: Use granular fill.
 - 2. Cover with granular fill.
 - 3. Fill up to subgrade elevation.
 - 4. Compact in maximum 8 inch lifts to 95 percent of maximum dry density.
- B. At Pipe Culverts:
 - 1. Bedding: Use granular fill.
 - 2. Cover with granular fill.
 - 3. Fill up to subgrade elevation.
 - 4. Compact in maximum 8 inch lifts to 95 percent of maximum dry density.
- C. Over Subdrainage Piping at Foundation Perimeter and Under Slabs:
 - 1. Drainage fill and geotextile fabric: Section 31 2323 and 33 46 00.
 - 2. Fill up to subgrade elevation.

3.07 TOLERANCES

A. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

3.08 FIELD QUALITY CONTROL

- A. See Section 01 40 00 Quality Requirements, for general requirements for field inspection and testing.
- B. Perform compaction density testing on compacted fill in accordance with ASTM D2922 or ASTM D3017.
- C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D1557 ("modified Proctor"), AASHTO T 180, or ASTM D698 ("standard Proctor").
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- E. Frequency of Tests: In conformance with current Oregon APWA/ODOT Standard Specifications for Construction.

3.09 CLEANING

- A. Leave unused materials in a neat, compact stockpile.
- B. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
- C. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

SECTION 31 23 23

FILL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Filling, backfilling, and compacting for building volume below grade, footings, slabs-on-grade, paving, site structures, utilities within the building, and retaining walls.
- B. Backfilling and compacting for utilities outside the building to utility main connections.
- C. Filling holes, pits, and excavations generated as a result of removal (demolition) operations.

1.02 RELATED REQUIREMENTS

- A. Section 01 57 13 Temporary Erosion and Sediment Control: Slope protection and erosion control.
- B. Section 03 30 00 Cast-in-Place Concrete.
- C. Section 31 22 00 Grading: Site grading.
- D. Section 31 23 16 Excavation: Removal and handling of soil to be re-used.
- E. Section 31 23 16.13 Trenching: Excavating for utility trenches outside the building to utility main connections.
- F. Section 33 41 00 Subdrainage: Filter aggregate and filter fabric for foundation drainage systems.
- G. Reference: Project Geotechnical Design Report as prepared by The Galli Group.

1.03 REFERENCE STANDARDS

- A. AASHTO T 180 Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; 2010.
- B. ASTM C136/C136M Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2014.
- C. ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012.
- D. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN m/m3)); 2012.
- E. ASTM D 2922 Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth); 2005.

1.04 DEFINITIONS

A. Finish Grade Elevations: Indicated on drawings.

1.05 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
- B. Soil Samples: 10 pounds sample of each type of fill; submit in air-tight containers to testing laboratory.
- C. Materials Sources: Submit name of imported materials source.
- D. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used, including manufactured fill.
- E. Compaction Density Test Reports.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. When necessary, store materials on site in advance of need.
- B. Verify that survey bench marks and intended elevations for the Work are as indicated.

PART 2 PRODUCTS

2.01 FILL MATERIALS

A. All materials shall be in accordance with the Project Geotechnical Design Report as prepared by The Galli Group.

2.02 ACCESSORIES

A. Geotextile Fabric: Non-biodegradable

- 1. Non-woven: PROPEX GEOTEX 801 or approved equal with laps per manufacturers specification.
- 2. Woven: PROPEX GEOTEX 200ST or approved equal with laps per manufacturers specification.
- 3. Filter: PROPEX GEOTEX 801 or approved equal.
- 4. Waterproof Membrane: 10 mil. thick by StegoWrap or approved equal installed per manufacturers specification.

2.03 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 Quality Requirements, for general requirements for testing and analysis of soil material.
- B. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Identify required lines, levels, contours, and datum locations.
- B. See Section 31 22 00 for additional requirements.
- C. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.
- D. Verify structural ability of unsupported walls to support imposed loads by the fill.
- E. Verify areas to be filled are not compromised with surface or ground water.

3.02 PREPARATION

- A. Scarify and proof roll subgrade surface to a depth of 6 inches to identify soft spots.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with structural fill.
- C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- D. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

3.03 FILLING

- A. Fill to contours and elevations indicated using unfrozen materials.
- B. Fill up to subgrade elevations unless otherwise indicated.
- C. Employ a placement method that does not disturb or damage other work.
- D. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Granular Fill: Place and compact materials in equal continuous layers in accordance with the Project Geotechnical Design Report as prepared by The Galli Group.
- G. Slope grade away from building minimum 2 inches in 10 feet, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- H. Correct areas that are over-excavated.
 - 1. Load-bearing foundation surfaces: Use structural fill, flush to required elevation, compacted to 100 percent of maximum dry density.
 - 2. Other areas: Use structural fill, flush to required elevation, compacted to minimum 95 percent of maximum dry density.
- I. Compaction densities shall be in accordance with the Project Geotechnical Design Report as prepared by The Galli Group.
- J. Reshape and re-compact fills subjected to vehicular traffic.

K. Maintain temporary means and methods, as required, to remove all water while fill is being placed as required, or until directed by the Engineer. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 Quality Requirements, for general requirements for field inspection and testing.
- B. Perform compaction density testing on compacted fill in accordance with ASTM D2922 or ASTM D3017.
- C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D698 ("standard Proctor"), ASTM D1557 ("modified Proctor"), or AASHTO T 180.
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- E. Frequency of Tests: In conformance with current Oregon APWA/ODOT Standard Specifications for Construction.
- F. Proof roll compacted fill at surfaces that will be under slabs-on-grade and paving.

3.05 CLEANING

- A. See Section 01 74 19 Construction Waste Management and Disposal, for additional requirements.
- B. Leave unused materials in a neat, compact stockpile.
- C. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

SECTION 32 11 23 AGGREGATE BASE COURSES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aggregate base course.
- B. Paving aggregates.

1.02 RELATED REQUIREMENTS

- A. Section 31 22 00 Grading: Preparation of site for base course.
- B. Section 31 23 16.13 Trenching: Compacted fill over utility trenches under base course.
- C. Section 31 23 23 Fill: Compacted fill under base course.
- D. Section 32 12 16 Hot Mix Asphalt Paving: Finish and binder asphalt courses.
- E. Section 32 13 13 Concrete Paving: Finish concrete surface course.
- F. Section 33 05 13 Manholes and Structures: Manholes including frames.
- G. Section 33 41 00 Subdrainage: Filter aggregate and filter fabric for foundation drainage systems.
- H. Reference: Project Geotechnical Design Report as prepared by The Galli Group.

1.03 REFERENCE STANDARDS

- A. AASHTO T 180 Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; 2010.
- B. ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012.
- C. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN m/m3)); 2012.
- D. ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.
- E. ASTM D 2922 Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth); 2005.
- F. ASTM D6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2010.

1.04 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements for submittal procedures.
- B. Samples: 10 lb sample of each type of aggregate; submit in air-tight containers to testing laboratory.
- C. Materials Sources: Submit name of imported materials source.
- D. Aggregate Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- E. Compaction Density Test Reports.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. When necessary, store materials on site in advance of need.
- B. Verify that survey bench marks and intended elevations for the Work are as indicated.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Materials in accordance with the Project Geotechnical Design Report as prepared by The Galli Group.
- B. Materials in compliance with the current Oregon/APWA Standard Specifications for Construction.
- C. Geotextile Fabric: Non-biodegradable
 - 1. Woven: PROPEX GEOTEX 200ST or approved equal with laps per manufacturers specification.

- 2. Non-woven: PROPEX GEOTEX 801 or approved equal with laps per manufacturers specification.
- 3. Filter: PROPEX GEOTEX 801 or approved equal.

2.02 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 Quality Requirements for general requirements for testing and analysis of aggregate materials.
- B. Where aggregate materials are specified using ASTM D2487 classification, test and analyze samples for compliance before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify substrate has been inspected, gradients and elevations are correct, and is dry.

3.02 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.
- B. Do not place aggregate on soft, muddy, or frozen surfaces.

3.03 INSTALLATION

- A. Place aggregate in maximum 8" layers and roller compact to specified density.
- B. Level and contour surfaces to elevations and gradients indicated.
- C. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
- D. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.04 TOLERANCES

A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.

3.05 FIELD QUALITY CONTROL

- A. See Section 01 40 00 Quality Requirements for general requirements for field inspection and testing.
- B. Compaction density testing will be performed on compacted aggregate base course in accordance with ASTM D1556, ASTM D2167, or ASTM D6938.
- C. Results will be evaluated in relation to compaction curve determined by testing uncompacted material in accordance with AASHTO T 180, ASTM D698 ("standard Proctor"), or ASTM D1557 ("modified Proctor").
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- E. Frequency of Tests: In conformance with current Oregon APWA/ODOT Standard Specifications for Construction.
- F. Proof roll compacted aggregate at surfaces that will be under slabs-on-grade and paving.

3.06 CLEANING

A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

SECTION 32 12 16 HOT MIX ASPHALT PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Single course asphalt concrete paving.
- B. Double course asphalt concrete paving.

1.02 RELATED REQUIREMENTS

- A. Section 31 22 00 Grading: Preparation of site for paving and base.
- B. Section 31 23 23 Fill: Compacted subgrade for paving.
- C. Section 32 11 23 Aggregate Base Courses: Aggregate base course.
- D. Section 32 13 13 Concrete Paving: Concrete curbs.
- E. Section 32 17 13 Parking Bumpers: Concrete or recycled rubber bumpers.
- F. Section 32 17 23.13 Painted Pavement Markings: Painted markings.
- G. Section 33 05 13 Manholes and Structures: Manholes, including frames; gutter drainage grilles, covers, and frames for placement by this section.
- H. Reference: Project Geotechnical Design Report as prepared by The Galli Group.

1.03 QUALITY ASSURANCE

- A. Perform Work in accordance with State of Oregon Highways standard.
- B. Mixing Plant: Complying with State of Oregon Highways standard.
- C. Obtain materials from same source throughout.

1.04 REGULATORY REQUIREMENTS

A. Conform to applicable code for paving work on public property. Coordinate all work within Public Right-of-Way with City/County inspector or ODOT.

1.05 FIELD CONDITIONS

A. Do not place asphalt when ambient air or base surface temperature is less than 40 degrees F, or surface is wet or frozen.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Aggregate Materials shall conform with Oregon Standard Specifications for Construction Section 00744.10.
- B. Asphalt Cement shall conform with Oregon Standard Specifications for Construction Section 00744.11.
- C. Mix Type and Broadband Limits shall conform with Oregon Standard Specifications for Construction Section 00744.12.
- D. Job Mix Formula (JMF) Requirements: Job mix formula requirements shall conform with Oregon Standard Specifications for Construction Section 00744.13.
- E. Tolerances and Limits: Tolerance and limits shall conform with Oregon Standard Specifications for Construction Section 00744.14.
- F. HMAC Acceptance: HMAC acceptance shall conform with Oregon Standard Specifications for Construction Section 00744.17.
- G. Asphalt Cement: PG 64-22.
- H. Aggregate for Base Course: In accordance with State of Oregon Highways standards.

2.02 EQUIPMENT

A. Compactors: Compactors shall conform with Oregon Standard Specifications for Construction - Section 00744.24.

2.03 LABOR

A. Quality Control Personnel: Provide quality control personnel in accordance with Oregon Standard Specifications for Construction - Section 00744.30.

2.04 ASPHALT PAVING MIXES AND MIX DESIGN

- A. Base Course: State of Oregon Highways standards, Level 2, 1/2" dense graded
- B. Wearing Course: State of Oregon Highways standards, Level 2, 1/2" dense graded
- C. Submit proposed mix design for review prior to beginning of work.

2.05 SOURCE QUALITY CONTROL

A. Test mix design and samples in accordance with ODOT/APWA Standard Specifications for Construction..

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that compacted subgrade is dry and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

3.02 PREPARATION - TACK COAT

- A. Apply tack coat in accordance with manufacturer's instructions.
- B. Apply tack coat on asphalt or concrete surfaces over subgrade surface at uniform rate of 1/3 gal/sq yd.
- C. Apply tack coat to contact surfaces of curbs, gutters and other vertical edges.
- D. Coat surfaces of manhole frames with oil to prevent bond with asphalt pavement. Do not tack coat these surfaces.

3.03 PLACING ASPHALT PAVEMENT - SINGLE COURSE

- A. Install Work in accordance with State of Oregon Highways standards.
- B. Place asphalt to per plan inch compacted thickness per plan inch compacted thickness.
- C. Install gutter drainage grilles and frames in correct position and elevation.
- D. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
- E. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

3.04 PLACING ASPHALT PAVEMENT - DOUBLE COURSE

- A. Place asphalt binder course within 24 hours of applying primer or tack coat.
- B. Place asphalt binder course to one-half total inch compacted thickness one-half total inch compacted thickness.
- C. Place asphalt wearing course within two hours of placing and compacting binder course.
- D. Place asphalt wearing course to one-half total inch compacted thickness one-half total inch compacted thickness.
- E. Install gutter drainage grilles and frames in correct position and elevation.
- F. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
- G. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

3.05 TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
- B. Compacted Thickness: Within 1/4 inch of specified or indicated thickness.
- C. Variation from True Elevation: Within 1/4 inch.

3.06 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for general requirements for quality control.

B. Provide field inspection and testing. Take samples and perform tests in accordance with ODOT/APWA Standards.

3.07 PROTECTION

A. Immediately after placement, protect pavement from mechanical injury for 5 days or until surface temperature is less than 140 degrees F.

SECTION 32 13 13 CONCRETE PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete sidewalks, stair steps, integral curbs, gutters, parking areas, and retaining walls.
- B. Cast in place paving and retaining walls: Specialty color and finishes.

1.02 RELATED REQUIREMENTS

- A. Section 03 10 00 Concrete Forming and Accessories.
- B. Section 03 30 00 Cast-in-Place Concrete.
- C. Section 31 22 00 Grading: Preparation of site for paving and base and preparation of subsoil at pavement perimeter for planting.
- D. Section 31 23 23 Fill: Compacted subbase for paving.
- E. Section 32 11 23 Aggregate Base Courses: Aggregate base course.
- F. Section 32 12 16 Hot Mix Asphalt Paving: Asphalt single and double course.
- G. Section 32 17 13 Parking Bumpers: Concrete and/or rubber parking bumpers.
- H. Section 32 17 26 Tactile Warning Surfacing: Plastic and/or cast iron tactile detectable warning tiles for pedestrian walking surfaces.
- I. Section 33 05 13 Manholes and Structures: Manholes, including frames; gutter drainage grilles, covers, and frames for placement by this section.
- J. Reference: Project Geotechnical Design Report as prepared by The Galli Group.

1.03 REFERENCE STANDARDS

- A. ACI 211.1 Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).
- B. ACI 304R Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000.
- C. ACI 305R Hot Weather Concreting; 2010.
- D. ACI 306R Cold Weather Concreting; 2010.
- E. ASTM A615/A615M Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2015.
- F. ASTM A1064/A1064M Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2015.
- G. ASTM C33/C33M Standard Specification for Concrete Aggregates; 2013.
- H. ASTM C39/C39M Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2015a.
- I. ASTM C94/C94M Standard Specification for Ready-Mixed Concrete; 2015.
- J. ASTM C150/C150M Standard Specification for Portland Cement; 2015.
- K. ASTM C173/C173M Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2014.
- L. ASTM C260/C260M Standard Specification for Air-Entraining Admixtures for Concrete; 2010a.
- M. ASTM C309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2011.
- N. ASTM C494/C494M Standard Specification for Chemical Admixtures for Concrete; 2013.
- O. ASTM C618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2015.
- P. ASTM C685/C685M Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2014.

- Q. ASTM D1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 2004 (Reapproved 2013).
- R. ASTM D1752 Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction; 2004a (Reapproved 2013).

1.04 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on joint filler, admixtures, and curing compound.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with ACI 301.
- B. Follow recommendations of ACI 305R when concreting during hot weather.
- C. Follow recommendations of ACI 306R when concreting during cold weather.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

PART 2 PRODUCTS

2.01 PAVING ASSEMBLIES

- A. Comply with applicable requirements of ACI 301.
- B. Concrete Curbs and Sidewalks: 3,500 psi 28 day concrete, 4 inches thick, buff color Portland cement, trowel finish.
- C. Parking/Driving Area Pavement: 4,000 PSI 28 day concrete, 6" thick, reinforcing per plan, trowel finish.
- D. Retaining Walls: As indicated per plans.

2.02 FORM MATERIALS

- A. Form Materials: As specified in Section 03 10 00, comply with ACI 301.
- B. Joint Filler: Preformed; non-extruding bituminous type (ASTM D1751) or sponge rubber or cork (ASTM D1752).
 - 1. Thickness: 3/8 inch.

2.03 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi) yield strength; deformed billet steel bars; unfinished.
- B. Steel Welded Wire Reinforcement: Plain type, ASTM A1064/A1064M; in flat sheets; unfinished.
- C. Dowels: ASTM A615/A615M, Grade 40 40,000 psi yield strength; deformed billet steel bars; unfinished finish.

2.04 CONCRETE MATERIALS

- A. Obtain cementitious materials from same source throughout.
- B. Concrete Materials: As specified in Section 03 30 00.

2.05 ACCESSORIES

A. Curing Compound: ASTM C309, Type 1, Class A.

2.06 CONCRETE MIX DESIGN; STANDARD COLORS AND FINISHES

- A. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
 - 1. For trial mixtures method, employ independent testing agency acceptable to Engineer for preparing and reporting proposed mix designs.
- B. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.
- C. Concrete Properties:

- 1. Compressive strength, when tested in accordance with ASTM C39/C39M at 28 days; 3,500 psi. (unless noted otherwise).
- 2. For concrete surfaces in areas supporting vehicular traffic, such as roadway aprons and loading zones, the concrete shall have a low to moderate flexural strength (modulus of rupture: 550 psi). This property shall be identified in the mix design.
- 3. Total Air Content: 6 percent, determined in accordance with ASTM C173/C173M.
- 4. Maximum Slump: 4 inches.
- 5. Maximum Aggregate Size: 3/4 inch.

2.07 CONCRETE MIX DESIGN; SPECIALTY COLORS AND FINISHES

- A. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
 - 1. For trial mixtures method, employ independent testing agency acceptable to Engineer for preparing and reporting proposed mix designs.
- B. Davis Color Additive: upon approval of sample, or approved.
 - 1. Rate of application by manufacturer, to be confirmed via mock-up.
 - 2. Colors: Pebble #641
- C. Other Admixtures: Add acceptable admixtures as recommended by integral color manufacturer.
- D. Finish: Chemical Surface Retarder
 - 1. ACC Top Face Surface Retarder: Micro Finish (05) Sand Finish Exposure, or approved.
- C. Concrete Properties:
 - 1. Compressive strength, when tested in accordance with ASTM C39/C39M at 28 days; 3,500 psi. (unless noted otherwise
 - 3. Total Air Content: 6 percent, determined in accordance with ASTM C173/C173M.
 - 4. Maximum Slump: 4 inches.
 - 5. Maximum Aggregate Size: 3/4 inch.

2.07 MIXING

A. Transit Mixers: Comply with ASTM C94/C94M.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify compacted granular base is acceptable and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

3.02 SUBBASE

A. See Section 32 11 23 for construction of base course for work of this Section.

3.03 PREPARATION

- A. Moisten base to minimize absorption of water from fresh concrete.
- B. Coat surfaces of manhole frames with oil to prevent bond with concrete pavement.
- C. Notify Engineer minimum 24 hours prior to commencement of concreting operations.

3.04 FORMING

- A. Place and secure forms to correct location, dimension, profile, and gradient.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement. Hold top of pre-molded joint filler down 1/2" and seal upper 3/8" with approved joint seal material.

3.05 REINFORCEMENT

A. Place reinforcement as indicated.

- B. Interrupt reinforcement at contraction joints.
- C. Place dowels to achieve pavement and curb alignment as detailed.

3.06 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304R.
- B. Ensure reinforcement, inserts, embedded parts, formed joints are not disturbed during concrete placement.
- C. Place concrete continuously over the full width of the panel and between predetermined construction joints.
- D. Place concrete to specified pattern.

3.07 JOINTS

- A. Align curb, gutter, and sidewalk joints.
- B. Place 3/8 inch wide expansion joints at 20 foot intervals and to separate paving from vertical surfaces and other components and in pattern indicated.
 - 1. Form joints with joint filler extending from bottom of pavement to within 1/2 inch of finished surface.
 - 2. Secure to resist movement by wet concrete.
- C. Provide scored joints.
- D. Install joints as specified on the plan set.

3.08 FINISHING

- A. Area Paving: Light broom, texture perpendicular to pavement direction.
- B. Sidewalk Paving: Light broom, texture perpendicular to direction of travel with troweled and radiused edge 1/4 inch radius.
- C. Curbs and Gutters: Light broom, texture parallel to pavement direction.
- D. Place curing compound on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.

3.09 TOLERANCES

- A. Maximum Variation of Surface Flatness: 1/4 inch in 10 ft.
- B. Maximum Variation From True Position: 1/4 inch.

3.10 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 Quality Requirements.
 - 1. Provide free access to concrete operations at project site and cooperate with appointed firm.
 - 2. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
 - 3. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.
- B. Compressive Strength Tests: ASTM C39/C39M; for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cu yd or less of each class of concrete placed.
 - 1. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
 - 2. Perform one slump test for each set of test cylinders taken.
- C. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.11 PROTECTION

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.
- B. Do not permit pedestrian traffic over pavement for 7 days minimum after finishing.

SECTION 32 14 13 PRECAST CONCRETE UNIT PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Interlocking concrete paver units.
- B. Detectable warning pavers.
- C. Sand setting bed.
- D. Polymeric sand joint filler.
- E. Edge restraints.

1.02 RELATED REQUIREMENTS

A. Section 32 13 13 - Concrete Paving: Concrete subbase for pavers.

1.03 REFERENCE STANDARDS

- A. ASTM C33/C33M Standard Specification for Concrete Aggregates 2018.
- B. ASTM C144 Standard Specification for Aggregate for Masonry Mortar 2018.
- C. ASTM C936/C936M Standard Specification for Solid Concrete Interlocking Paving Units 2021b.

1.04 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide characteristics of paver unit, detectable warning pavers, dimensions, and special shapes.
- C. Product Data: Provide characteristics of polymeric sand, including base material, additive(s), compressive strength, and color.
- D. Samples: Submit two samples of each paver type, illustrating style, size, color range and surface texture of units being provided.
- E. Manufacturer's Installation Instructions: Indicate substrate requirements and installation methods.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Interlocking Permeable Concrete Pavers:
 - 1. Stepstone Inc.; Narrow Modular Paver: https://www.stepstoneinc.com
 - 2. Unilock; Promenade Plank Pavers: www.unilock.com/#sle.

2.02 MATERIALS

- A. Interlocking Concrete Pavers: Hydraulically pressed concrete, configured for interlocking with adjacent units and complying with ASTM C936/C936M.
 - 1. Compressive Strength: 8000 pounds per square inch average, with minimum of 7200 pounds per square inch.
 - 2. Size A: 3 x 24 inch, and
 - 3. Size B: 3 x 9 inch.
 - 4. Thickness: 2-3/8 inches.
 - 5. Type: Rectangular.
 - 6. Pattern: Rrunning bond, alternating rows with size A and B.
 - 7. Color: Caramel.
 - 8. Finish texture: Broom Finish
- B. Detectable Warning Pavers: Cast concrete with truncated domes, Charcoal color.
- C. Sand for Setting Bed: Clean washed natural sand or crushed stone complying with gradation requirements of ASTM C33/C33M for fine aggregates.

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- D. Polymeric Sand: Fine sand complying with ASTM C144 combined with polymer binders for creating semi-solid joints between pavers.
 - 1. Color: Match to Paver Color.
- E. Edging: Concrete block out, as detailed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate is level or to correct gradient, smooth, capable of supporting pavers and imposed loads, and ready to receive work of this Section.
- B. Verify gradients and elevations of substrate are correct.
- C. Verify dry weather forecast without rain for a minimum of 24 hours with temperatures above 55 degrees Fahrenheit.
- D. Verify that pavers are completely dry prior to polymeric sand installation.

3.02 PREPARATION

A. See Section 32 13 13 for concrete subbase.

3.03 INSTALLATION OF SOLID PAVER UNITS

- A. Spread sand bedding evenly over prepared substrate surface to a maximum thickness of 1-1/2 inch.
- B. Dampen and roller compact sand to level and even surface.
- C. Screed and scarify top 1 inch to 1 1/2 inch of sand.
- D. Place paver units in perpendicular running bond pattern creating staggered joints, from straight reference edge.
- E. Cut paver units at edges with masonry saw.
- F. Place half units at edge and interruptions. Maintain tight interior joints and 1/2 inch perimeter joints. 1/8 inch maximum tollerance on perimeter joint width.
- G. Spread polymeric sand uniformly over perimeter of unit paving area between edge and adjacent concrete surface. Interior of tightly butted unit paving does not require joint sand. Use a push broom to fill joints and remove excess while not sweeping long distances. Sweep all excess with a fine bristle brush and remove residues with a leaf blower.
- H. Where paver perimeter abuts an expansion joint, use paver polymeric sand as finished top of expansion joint material.
- I. Tamp and level paver units with mechanical vibrator until units are firmly bedded, level, and to correct elevation and gradients. Do not tamp unrestrained edges.
- J. Using a sprayer set to shower, apply water on specific areas between 100 square feet and 200 square feet to a depth of 1 1/2 inches. Complete one section at a time and avoid flooding the pavers.

3.04 CLEANING

- A. Do not clean pavers until pavers and polymeric jointing sand are dry.
- B. Clean soiled surfaces using cleaning solution. Do not harm pavers, joint materials, or adjacent surfaces.
- C. Use non-metallic tools in cleaning operations.
- D. Rinse surfaces with clean water.
- E. Broom clean paving surfaces. Dispose of excess sand.

3.05 PROTECTION

A. Do not permit traffic over unprotected paver surface.

B. Protect paver surface with sheets of plywood.

SECTION 32 17 13 PARKING BUMPERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Precast concrete parking bumpers and anchorage.
- B. Recycled rubber parking bumpers and anchorage.

1.02 REFERENCE STANDARDS

- A. ASTM A615/A615M Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2015.
- B. ASTM C150/C150M Standard Specification for Portland Cement; 2015.
- C. ASTM C260/C260M Standard Specification for Air-Entraining Admixtures for Concrete; 2010a.
- D. ASTM C330/C330M Standard Specification for Lightweight Aggregates for Structural Concrete; 2014.

1.03 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide unit configuration, dimensions.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Parking Bumpers: Precast concrete, complying with the following:
 - 1. Nominal Size: 4-6 inches high, 6-8 inches wide, 5-6 feet long.
 - 2. Cement: ASTM C150/C150M, Portland Type I Normal; white color.
 - 3. Concrete Materials: ASTM C330/C330M aggregate, water, and sand.
 - 4. Reinforcing Steel: ASTM A615/A615M, deformed steel bars; unfinished, strength and size commensurate with precast unit design.
 - 5. Air Entrainment Admixture: ASTM C260/C260M.
 - 6. Concrete Mix: Minimum 5,000 psi compressive strength after 28 days, air entrained to 5 to 7 percent.
 - 7. Use rigid molds, constructed to maintain precast units uniform in shape, size and finish. Maintain consistent quality during manufacture. Embed reinforcing steel, and drill or sleeve for two dowels.
 - 8. Cure units to develop concrete quality, and to minimize appearance blemishes such as nonuniformity, staining, or surface cracking. Minor patching in plant is acceptable, providing appearance of units is not impaired.
- B. Parking Bumpers: Recycled rubber, conforming to the following:
 - 1. Nominal Size: 4-6 inches high, 6-8 inches wide, 5-6 feet long.
 - 2. 100% recycled plastic and/or rubber that will not crack.
 - 4. Impervious to salt, oil, gasoline, and other road chemicals.
 - 5. Optional colors available for ADA parking spaces (blue).

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install units without damage to shape or finish. Replace or repair damaged units.
- B. Install units in alignment with adjacent work per manufacturers specifications.
- C. Fasten units in place with 3 dowels per unit.

SECTION 32 17 23.13 PAINTED PAVEMENT MARKINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Parking lot markings, including parking bays, crosswalks, arrows, handicapped symbols, and curb markings.
- B. Roadway lane markings and crosswalk markings.
- C. "No Parking Fire Lane" curb painting.

1.02 RELATED REQUIREMENTS

- A. Section 32 12 16 Hot Mix Asphalt Paving.
- B. Section 32 13 13 Concrete Paving.

1.03 REFERENCE STANDARDS

- A. FS TT-P-1952 Paint, Traffic Black, and Airfield Marking, Waterborne; Rev. E, 2007.
- B. MPI (APL) Master Painters Institute Approved Products List; Master Painters and Decorators Association; current edition, www.paintinfo.com.
- C. FHWA MUTCD Manual on Uniform Traffic Control Devices for Streets and Highways; U.S. Department of Transportation, Federal Highway Administration; Current Edition.

1.04 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
- 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.
- C. Certificates: Submit for each batch of paint and glass beads stating compliance with specified requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver paint in containers of at least 5 gallons accompanied by batch certificate.
- B. Store products in manufacturer's unopened packaging until ready for installation.
- C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.06 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.07 EXTRA MATERIALS

- A. See Section 01 60 00 Product Requirements, for additional provisions.
- B. Supply 2 containers of each color for Owner's use.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Line and Zone Marking Paint: MPI (APL) No. 97 Latex Traffic Marking Paint; color(s) as indicated.
 - 1. Parking Lots: White.
 - 2. Handicapped Symbols: Blue.
 - 3. Crosswalks: White.
 - 4. Fire Lane: Red with White text.
- B. Paint For Obliterating Existing Markings: FS TT-P-1952; black for bituminous pavements, gray for Portland cement pavements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Engineer of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of marking materials.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Clean surfaces thoroughly prior to installation.
 - 1. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods.
 - 2. Completely remove rubber deposits, existing paint markings, and other coatings adhering to the pavement, by scraping, wire brushing, sandblasting, mechanical abrasion, or approved chemicals.
- D. Where oil or grease are present, scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application; after cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through the new paint.
- E. Establish survey control points to determine locations and dimensions of markings; provide templates to control paint application by type and color at necessary intervals.
- F. Temporary Pavement Markings: When required or directed by Engineer, apply temporary markings of the color(s), width(s) and length(s) as indicated or directed.
 - 1. After temporary marking has served its purpose, remove temporary marking by carefully controlled sandblasting, approved grinding equipment, or other approved method so that surface to which the marking was applied will not be damaged.

3.03 INSTALLATION

- A. Begin pavement marking as soon as practicable after surface has been cleaned and dried.
- B. Apply in accordance with manufacturer's instructions using an experienced technician that is thoroughly familiar with equipment, materials, and marking layouts.
- C. Comply with FHWA MUTCD manual (http://mutcd.fhwa.dot.gov) for details not shown.
- D. Apply markings in locations determined by measurement from survey control points; preserve control points until after markings have been accepted.
- E. Apply uniformly painted markings of color(s), lengths, and widths as indicated on drawings true, sharp edges and ends.
 - 1. Apply paint in two coats.
 - 2. Wet Film Thickness: 0.015 inch, minimum.
 - 3. Width Tolerance: Plus or minus 1/8 inch.
- F. Roadway Traffic Lanes: Use suitable mobile mechanical equipment that provides constant agitation of paint and travels at controlled speeds.
 - 1. Conduct operations in such a manner that necessary traffic can move without hindrance.
 - 2. Place warning signs at the beginning of the wet line, and at points well in advance of the marking equipment for alerting approaching traffic from both directions. Place small flags or other similarly effective small objects near freshly applied markings at frequent intervals to reduce crossing by traffic.
 - 3. If paint does not dry within expected time, discontinue paint operations until cause of slow drying is determined and corrected.

- 4. Skip Markings: Synchronize one or more paint "guns" to automatically begin and cut off paint flow; make length of intervals as indicated.
- 5. Use hand application by pneumatic spray for application of paint in areas where a mobile paint applicator cannot be used.
- G. Parking Lots: Apply parking space lines, entrance and exit arrows, painted curbs, and other markings indicated on drawings.
 - 1. Mark the International Handicapped Symbol at indicated parking spaces.
 - 2. Hand application by pneumatic spray is acceptable.
- H. Symbols: Use a suitable template that will provide a pavement marking with true, sharp edges and ends, of the design and size indicated.

3.04 DRYING, PROTECTION, AND REPLACEMENT

- A. Protect newly painted markings so that paint is not picked up by tires, smeared, or tracked.
- B. Provide barricades, warning signs, and flags as necessary to prevent traffic crossing newly painted markings.
- C. Allow paint to dry at least the minimum time specified by the applicable paint standard and not less than that recommended by the manufacturer.
- D. Remove and replace markings that are applied at less than minimum material rates; deviate from true alignment; exceed length and width tolerances; or show light spots, smears, or other deficiencies or irregularities.
- E. Remove markings in manner to avoid damage to the surface to which the marking was applied, using carefully controlled sand blasting, approved grinding equipment, or other approved method.
- F. Replace removed markings at no additional cost to Owner.

SECTION 32 17 26 TACTILE WARNING SURFACING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tactile and detectable warning tiles for pedestrian walking surfaces.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 Cast-in-Place Concrete: Concrete for sidewalks and platforms.
- B. Section 32 13 13 Concrete Paving: Concrete sidewalks.
- C. Section 32 17 23.13 Painted Pavement Markings: Crosswalk and curb markings.

1.03 REFERENCE STANDARDS

- A. 49 CFR 37 Transportation Services for Individuals with Disabilities (ADA); current edition.
- B. AASHTO LRFD Bridge Design Specifications, Customary U.S. Units (6th Edition); 2012.
- C. ADA Standards Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- D. ASTM A48/A48M Standard Specification for Gray Iron Castings; 2003 (Reapproved 2012).
- E. ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- F. ASTM B117 Standard Practice for Operating Salt Spray (Fog) Apparatus; 2011.
- G. ASTM C501 Standard Test Method for Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser; 1984 (Reapproved 2009).
- H. ASTM C903 Standard Practice for Preparing Refractory Castable Specimens by Cold Gunning; 2010.
- I. ASTM D2047 Standard Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine; 2011.
- J. ASTM D543 Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents; 2014.
- K. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- L. ASTM G155 Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials; 2013.

1.04 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturer's product data, standard details, details specific to this project; written installation and maintenance instructions.
- C. Shop Drawings: Submit plan and detail drawings. Indicate:
 - 1. Locations on project site. Demonstrate compliance with referenced accessibility standards.
 - 2. Sizes and layout.
 - 3. Pattern spacing and orientation.
 - 4. Attachment and fastener details, if applicable
- D. Warranty: Submit manufacturer warranty; complete forms in Owner's name and register with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver to project site in manufacturer's protective wrapping and in manufacturer's unopened packaging.

B. Store covered and elevated above grade and in manufacturer's unopened packaging until ready for installation. Maintain at ambient temperature between 40 and 90 degrees F.

1.07 WARRANTY

- A. See Section 01 78 00 Closeout Submittals, for additional warranty requirements.
- B. Cast Iron Tiles: Provide manufacturer's standard ten year warranty against manufacturing defects, breakage or deformation.
- C. Plastic Tiles: Provide manufacturer's standard five year warranty against manufacturing defects, breakage or deformation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Plastic Tactile and Detectable Warning Surface Tiles:
 - 1. Access Tile, a brand of Access Products, Inc.: www.accesstile.com
 - 2. ADA Solutions, Inc.: www.adatile.com
 - 3. Armor-Tile, a brand of Engineered Plastics, Inc.: www.armortiletransit.com
- B. Cast Iron Detectable Warning Plates:
 - 1. ADA Solutions, Inc.: www.adatile.com
 - 2. EJ: www.ejco.com
 - 3. Neenah Foundry, a division of Neenah Enterprises, Inc.: www.nfco.com

2.02 TACTILE AND DETECTABLE WARNING DEVICES

- A. Plastic Tactile and Detectable Warning Tiles: ADA Standards compliant, glass fiber and carbon fiber reinforced, exterior grade, matte finish polyester sheet with truncated dome pattern, solid color throughout, internal reinforcing of sheet and of truncated domes, integral radius cut lines on back face of tile; with factory-applied removable protective sheeting.
 - 1. Material Properties:
 - a. Slip Resistance: 0.50 minimum dry static coefficient of friction, when tested in accordance with ASTM D2047.
 - Chemical Stain Resistance: No reaction to 1 percent hydrochloric acid, motor oil, calcium chloride, gum, soap solution, bleach, or antifreeze, when tested in accordance with ASTM D543.
 - c. Abrasion Resistance: 300, minimum, when tested in accordance with ASTM C501.
 - d. Flame Spread Index: 25, maximum, when tested in accordance with ASTM E84.
 - e. Accelerated Weathering: Delta-E of less than 5.0 at 2,000 hours exposure, when tested in accordance with ASTM G155.
 - f. Adhesion: No delamination of tile prior to board failure in a temperature range of 20 to 180 degrees F, when tested in accordance with ASTM C903.
 - g. Loading: No damage when tested according to AASHTO LRFD test method HS20.
 - h. Salt and Spray Performance: No deterioration or other defect after 200 hours of exposure, when tested in accordance with ASTM B117.
 - 2. Installation Method: Cast in place.
 - 3. Shape: Rectangular.
 - 4. Square Dimensions: per plan inches by per plan inches.
 - 5. Pattern: In-line pattern of truncated domes complying with ADA Standards.
 - 6. Edge: Square.
 - 7. Joint: Butt.
 - 8. Color: As selected by Engineer from manufacturer's standard range.
- B. Cast Iron Detectable Warning Plates:
 - 1. Material: Cast gray iron; ASTM A48/A48M, Class 30 A (minimum).
 - 2. Installation Method: Cast in place.

- 3. Shape: Rectangular.
 - 4. Square Dimensions: per plan inches by per plan inches.
 - 5. Pattern: Truncated cones in compliance with ADA Standards.
 - 6. Joint: Manufacturer standard, bolted connection.
 - 7. Finish: Manufacturer's factory-applied powder coat.
 - 8. Color: As selected by Engineer from manufacturer's standard range.

2.03 ACCESSORIES

- A. Fasteners: ASTM A666, Type 304 stainless steel
 - 1. Type: Countersunk, color matched composite sleeve anchors
 - 2. Size: 1/4 inch diameter and 1-1/2 inches long.
- B. Adhesive: Type recommended and approved by surfacing tile manufacturer.
- C. Sealant: Elastomeric sealant of color to match adjacent surfaces; approved by surfacing tile manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. When installation location is near site boundary or property line, verify required location using property survey.
- B. Verify that work area is ready to receive work:
 - 1. If existing conditions are not as required to properly complete the work of this section, notify Engineer.
 - 2. Do not proceed with installation until deficiencies in existing conditions have been corrected.
- C. Verify that dimensions, tolerances, and attachment methods for work in this section are properly coordinated with other work on site.

3.02 INSTALLATION, GENERAL

- A. Install in accordance with manufacturer's written instructions.
 - 1. Do not install damaged, warped, bowed, dented, abraded, or otherwise defective units.
 - 2. Do not install when ambient or substrate temperature has been below 40 degrees F during the preceding 8 daylight hours.
- B. Field Adjustment:
 - 1. Locate relative to curb line in compliance with ATBCB PROWAG, Sections 304 and 305.
 - 2. Orient so dome pattern is aligned with the direction of ramp.
- C. Install units fully seated to substrate, square to straight edges and flat to required slope.

3.03 INSTALLATION, CAST IN PLACE PLASTIC TILES

- A. Concrete:
 - 1. See Section 03 30 00.
 - 2. Slump: 4 to 7 percent.
- B. Tamp and vibrate units as recommended by manufacturer.
- C. Place and position weights on units while concrete cures as recommended by manufacturer. Ensure no voids or air pockets exist between top surface of concrete and underside of units.

3.04 INSTALLATION, SURFACE APPLIED PLASTIC TILES

- A. Cure concrete surfaces for a minimum of 4 days before installing units.
- B. Mechanically roughen surface as required to remove contaminants and prepare surface for adhesive and sealant application.
- C. Drill fastener holes straight, true and to depth recommended by manufacturer.
- D. Apply adhesive to back of unit as recommended by manufacturer.

- E. Mechanically fasten to substrate. Avoid striking or damaging the unit itself during installation.
- F. Apply sealant to edges in cove profile.

3.05 INSTALLATION - CAST IN PLACE, CAST IRON PLATES

- A. Install by method described in manufacturer's written instructions.
- B. Place units into wet concrete.
- C. Press assembly into concrete to achieve final elevation.
- D. Finish concrete adjacent to plate. Remove wet concrete spilled onto plate surface.

3.06 CLEANING PLASTIC UNITS

- A. Remove protective plastic sheeting within 24 hours of installation.
- B. Remove excess sealant or adhesive from joints and edges.
- C. Clean 2 days prior to date of scheduled inspection.

3.07 PROTECTION

- A. Protect installed units from traffic, subsequent construction operations or other imposed loads until concrete is fully cured.
- B. Touch-up, repair or replace damaged products prior to Date of Substantial Completion.

SECTION 32 33 00 SITE FURNISHINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Benches.
- B. Bollards.
- C. Planter Pots.
- D. Tables & Chairs
- E. Umbrellas.

1.02 REFERENCE STANDARDS

- A. ADA Standards 2010 ADA Standards for Accessible Design 2010.
- B. ASTM A36/A36M Standard Specification for Carbon Structural Steel 2019.
- C. ASTM A53/A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.
- D. ASTM A500/A500M Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes 2021a.
- E. ASTM B211/B211M Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire 2019.

1.03 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's specifications and descriptive literature, installation instructions, and maintenance information.
- C. Shop Drawings: Indicate plans for each unit or group of units, elevations with model number, overall dimensions, construction, and anchorage details.
- D. Samples: Submit two sets of manufacturer's available colors for metal furnishings.
- E. Samples: Submit two sets of manufacturer's available colors and finishes for precast furnishings.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Furnishings:
 - 1. Landscape Forms, Inc: www.landscapeforms.com/#sle.
- B. Precast Furnishings:
 - 1. Tournesol Siteworks, LLC: www.tournesol.com/#sle.
 - 2. Substitutions: See Section 01 60 00 Product Requirements.

2.02 METAL FURNISHINGS

- A. Metal Furnishings, General:
 - 1. Steel components: Plates, bars, and shapes complying with ASTM A36/A36M and tubing complying with ASTM A500/A500M; cleaned, treated, and powder-coated.
 - 2. Aluminum Components: ASTM B211/B211M.
 - a. Color: As selected by Owner's Representative from manufacturer's custom range.
 - 3. Hardware: Stainless steel.
- B. Benches: Metal frame and seat section with back.
 - 1. Frame: Aluminum.
 - 2. Seat and Back: Aluminum.
 - 3. Length: 67 inches.
 - 4. Width: 25 inches.

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- 5. Height: 35 inches.
- 6. Mounting: Surface.
- 7. Products:
 - a. Free Standing Bench
 - 1) Lakeside Bench with back and arms, rain pattern modification to match chairs.
- C. Metal Tables and Seating:
 - 1. Frame: Aluminum.
 - 2. Back and Seat: Aluminum.
 - 3. Seating: Compliant with ADA Standards.
 - 4. Shape: Round.
 - 5. Mounting: Freestanding.
 - 6. Products:
 - a. Chair
 - 1) Windmark Chair, rain pattern, with arms, by Landscapeforms.
 - b. Table
 - 1) Windmark Table, round top, by Landscapeforms.
- D. Umbrellas:
 - 1. Frame: Aluminum. 8ft height
 - 2. Canopy: Canvas. 9ft diameter.
 - 3. Products:
 - a. SiteScapes, Inc; UM3091: www.sitescapesonline.com/#sle.
 - b. Shelter Outdoor; P50: www.shelteroutdoor.com/product/p50-umbrella
 - c. Substitutions: See Section 01 60 00 Product Requirements.

2.03 PRECAST CONCRETE FURNISHINGS

- A. Precast Concrete Furnishings, General:
 - 1. Precast Concrete Components: GFRC Lightweight Concrete with ingetgral color pigment.
 - a. Finish:
 - 1) Natural Sand Texture
 - 2) Horizontal Surfaces: Smooth for seats and table tops.
 - 3) Vertical Surfaces: Smooth for supports and sides.
 - b. Color: As selected by Architect from manufacturer's standard range.
 - c. Clear Sealers: Anti-graffiti.
 - 2. Hardware: Stainless steel.
- B. Planter Pots: Precast concrete with drain holes.
 - 1. Shape: Prismatic.
 - 2. Type 1:
 - a. Diameter: 24 inches.
 - 3. Type 2:
 - a. Diameter: 36 inches.
 - b. Height: 33 inches.
 - 4. Mounting: Freestanding.
 - 5. Interior Water Sealant: Elastomeric coating.
 - 6. Products:
 - a. Harlie Pots by Tournesol Siteworks
 - b. Model number: HS 2400 and HS 3600

2.04 BOLLARDS

- A. Steel Pipe Bollards: Hollow steel pipe with plain shaft.
 - 1. Shape: Square.
 - 2. Width: 3" inches.
 - 3. Cap: Flat steel plate.
 - 4. Materials:
 - a. Steel Pipe: ASTM A53/A53M, standard weight.

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- b. Factory Finish: Hot-dipped galvanized.
- c. Color: As selected by Architect from manufacturer's standard range.
- 5. Mounting: In-ground.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify proper installation of mounting surfaces, preinstalled anchor bolts, and other mounting devices; and ready to receive site furnishing items.
- B. Do not begin installation until unacceptable conditions are corrected.

3.02 INSTALLATION

- A. Install site furnishings in accordance with approved shop drawings, and manufacturer's installation instructions.
- B. Provide level mounting surfaces for site furnishing items.

SECTION 32 33 13 SITE BICYCLE RACKS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior bicycle racks.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Mounting surface for bicycle racks.

1.03 REFERENCE STANDARDS

A. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.

1.04 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements for submittal procedures.
- 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.
- C. Shop Drawings: Indicate size, shape, and dimensions, including clearances from adjacent walls, doors, and obstructions.
- D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Handle racks with sufficient care to prevent scratches and other damage to the finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Exterior Bicycle Racks:
 - 1. Huntco Supply, LLC; The Arc Bike Rack: www.huntco.com/#sle.
 - 2. MADRA , a brand of Graber Manufacturing, Inc; Wingra Bike Rack: www.madrax.com/#sle.
 - 3. SiteScapes, Inc; A-Frame Bike Rack: www.sitescapesonline.com/#sle.

2.02 BICYCLE RACKS

- A. Exterior Bicycle Racks: Device allows user-provided lock to simultaneously secure one wheel and part of the frame on each bicycle parked or racked.
 - 1. Style: Inverted horseshoe rack formed by one u-shaped bend of round pipe.
 - 2. Capacity: 19 bicycles.
 - 3. Mounting, Ground: Surface flange.
 - 4. Finish: Powder coat, maintenance-free and weather-resistant.
 - 5. Color: As selected by Owner's Representative from manufacturer's standard range.
- B. Materials:
 - 1. Pipe: Carbon steel, ASTM A53/A53M, Schedule 40.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine surfaces to receive bicycle racks.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory conditions before proceeding.
- C. Do not begin installation until unsatisfactory conditions are corrected.

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3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install level, plumb, square, and correctly located as indicated on drawings.
- C. Surface Flange Installation: Anchor bicycle racks securely in place with 1/2 inch by 4 inch anchor bolts through flange holes.

3.03 CLEANING

A. Clean installed work to like-new condition. Do not use cleaning materials or methods that could damage finish.

3.04 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

SECTION 32 80 00 IRRIGATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Installation of Backflow Prevention Assembly and related appurtenances.
- B. Installation of an electric solenoid controlled underground sprinkler system of PVC pipe and fittings with pop-up heads and dripline.
- C. Installation of Irrigation Control Assembly and control wires, at new shrub zones.
- D. Installation of drip irrigation system at shrubs zones.

1.02 RELATED REQUIREMENTS

- A. Section 01 60 00 Product Requirements
- B. Division 26 Electrical
- C. Division 31 Earthwork
- D. Section 32 91 19 Landscape Grading
- E. Section 32 93 00 Plants

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the work with other trades affecting and affected by Work of this Section.
- B. Preinstallation Meeting: Convene one week (minimum) prior to commencing work of this Section to coordinate utility marking procedures.

1.04 SUBMITTALS

A. See Section 01 60 00 - Product Requirements for submittal procedures.

1.05 INFORMATION SUBMITTALS

- A. Installer Qualifications:
 - 1. Company specializing in performing Work of this Section who has successfully completed a minimum of 5 comparable scale projects and have the following licenses:
 - a. For Irrigation Work:
 - 1) Valid Oregon Landscape Contractors license.
 - 2) Valid Oregon Landscape Business license.
 - b. For Plumbing Work:
 - 1) Valid Oregon Plumbing license.
 - 2) Valid Oregon Landscape Contractor license.
 - c. Successfully completed at least 5 comparable scale projects.
 - 1) Submit names, addresses, dates, owners and locations of previous projects if requested by Architect.
- B. Quality Assurance Data:
 - 1. Submit license information and project references including name and location of previous projects, date of installation, square footage of areas with irrigation work, description of irrigation system, and Owner's contact information.
- C. Controller Programming Schedule:
 - 1. Prepare a program for the irrigation controller for Spring/Summer-Summer/Summer/Fall. Indicate start times, watering duration, day of week, repeat cycle mode, program mode, precipitation rates in inches per hour, and application quantities. Coordinate operation and programming with Architect.
- D. Zoning Chart:
 - 1. Submit colored and laminated chart showing each zone and their actual precipitation rates.

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1.06 ACTION SUBMITTALS

- A. Shop Drawings:
 - 1. Submit shop drawings called for in the installation details. Show products required for proper installation, their relative locations, and critical dimensions. Note modifications to installation details.
- B. Product Data:
 - 1. Submit Manufacturer's catalog cut sheets, specifications, and installation instructions for all material as noted in this section and on drawings. Failure to do so may result in non-acceptance of materials already used or hauled to the site. Any removal or delays incurred will be at the expense of the Contractor

1.07 CLOSEOUT SUBMITTALS

A. Record Drawings:

- 1. Keep one complete set of contract documents as Project Documents. Keep documents current. Do not permanently cover work until as-built information is recorded.
- 2. Record work which is installed differently than shown on the construction drawings.
- 3. Record accurate reference dimensions, measured from at least two permanent reference points, of each irrigation system valve, each backflow prevention device, each sleeve end, each main line stub out, and other irrigation components enclosed within a valve box. Use red ink to legibly re-draft actual dimensions of installed work. Include location of surge protection, and sensors used in the project.
- 4. Include GPS coordinates for all valves and sensors used on project.
- 5. Submit project record (as-built) drawings to Architect for approval prior to system demonstration to Owner.
- 6. Completion of the Record Drawings will be a prerequisite for the Final Completion Review.
- B. Operation and Maintenance Data:
 - 1. Written instructions for operation and maintenance of system and controls, seasonal activation and shutdown, and manufacturer's parts catalog.

1.08 MAINTENANCE MATERIAL SUBMITTAL

- A. Provide the following for Owner's use in maintenance of project.
 - 1. Extra Valve Keys for Manual Valves: One.
 - 2. Extra Valve Box Keys: One.
 - 3. Wrenches: One for each type head core and for removing and installing each type head.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in original unopened packaging with legible manufacturer's identification.
- B. Comply with manufacturer's recommendations for storage and protection.
 - 1. Store in a cool, dry place out of direct sunlight.
 - 2. Protect from damage by the elements and construction procedures.
 - 3. Store plastic pipe on firm, level supports.
 - 4. Store plastic pipe cement in cool location.

1.10 ENVIRONMENTAL CONDITIONS

A. Temperature of mating surfaces of plastic pipe and fittings to be between 40 degrees Fahrenheit and 100 degrees Fahrenheit. Perform no PVC Solvent welding in rainy weather except under cover.

1.11 REVIEWS

- A. Request the following reviews by the Architect two days (min.) in advance:
 - 1. Irrigation Head Layout
 - 2. Pressure Test and Mainline Installation
 - 3. Substantial Completion
 - 4. System Demonstration to Owner
 - 5. Final Completion

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B. Coordinate Reviews to coincide with regular progress meetings where possible.

1.12 MAINTENANCE

A. During period between system installation and Final Completion Review provide maintenance to assure proper operation of the irrigation system.

1.13 WARRANTY

- A. See Section 01 78 00 Closeout Submittals, for additional warranty requirements.
- B. Provide one year warranty following Final Completion granted by Architect or one full growing season following Final Completion, whichever is later.
- C. Inspection: Visit work at least once a month during warranty period. Notify Architect and Owner in writing of any observed conditions requiring attention. Failure to provide such notification renders any deficiencies the Contractor's responsibility to rectify.
- D. At the end of the warranty period, as directed by Architect and at no additional cost to the Owner:
 - 1. Irrigation system must be in proper working condition.
 - 2. Replace work of this Section as necessary to restore system to proper working condition following the Contract Documents.
 - 3. Complete corrective warranty work within 30 days of warranty review.
- E. Contractor is not responsible for loss or damage to Work of theis Section caused by unusually extreme weather, vandalism, or lack of Owner's maintenance during warranty period.

PART 2 PRODUCTS

2.01 IRRIGATION SYSTEM MATERIALS

- A. Use only new materials of brands and types shown on Drawings or specified herein.
- B. Similar materials must be products of one manufacturer unless otherwise approved.
- C. Substitutions: See Section 01 60 00 Product Requirements.

2.02 PIPE MATERIALS

- A. Mainline Pipe, Lateral Line Pipe, and Irrigation Sleeves: Schedule 40 PVC Pipe, Type 1, normal impact: IPS, NSF approved conforming to ASTM D1784, ASTM D1785.
 - 1. Mainline Size: 3" Throughout
 - 2. Lateral and Sleeves: Per Drawing
- B. Risers: One piece schedule 80 gray PVC Pipe, Type 1, threaded at both ends conforming to ASTM D1784 and ASTM D2464. No snap-risers.
- C. Fittings: Polyvinyl chloride type 1, white schedule 40 and gray schedule 80; ASTM D1784, ASTM D2466, or ASTM D2464, as applicable.
- D. Irrigation Sleeves: Schedule 40 PVC Pipe, Type 1, normal impact: IPS, NSF approved conforming to ASTM D1784, ASTM D1785.
- E. Electrical Conduit and Fittings:
 - 1. Underground: Plastic, Class 3, Federal Specification W-C-1094.
 - 2. Above Ground: Aluminum, Federal Specification WW-G-540.
- F. PVC Solvent Cement: NSF approved solvent for Class 1245-B&C PVC through 4 inches conforming to ASTM D 2564 for PVC pipe and fittings. Ensure that manufacturer's expiration date is not exceeded.
 - 1. At main lines: IPS Corporation Weld-On #705 PVC.
 - 2. At lateral lines: IPS Corporation Weld-On #705 PVC or #721 PVC.
- G. PVC Cleaner and Primer:
 - 1. IPS Weld-on P-70 or as recommended by PVC Pipe manufacturer.
 - 2. Oatey Lo-V.O.C. Purple Primer #31903.

2.03 DRIP LINE MATERIALS

- A. Drip Line: Netafim, as indicated on drawings.
- B. Fittings: Netafim, as indicated on drawings.
- C. Flush Cap: Netafim, as indicated on drawings.
- D. Soil Staples: Metal staple style, 6" min length by Netafim, TLS6.

2.04 VALVES

- A. Isolation Valves 3 inch and under: Threaded gate valve with resilient wedge sized to match mainline with wheel handle.
 - 1. Approved Products:
 - a. Kennedy C-509 Figure Number 8057SS, or approved.
 - b. Nibco T-113 gate valve with bronze handle, or approved.
- B. Control Valve Assembly:
 - 1. Automatic Control Valve: Globe type, 200 psi rated, threaded connections with cross type operating handle designed to receive operating key. Size according to Valve Schedule on Drawing.
 - a. Approved Products:
 - b. Approved Products:
 - 1) Rain Bird PEB-PRS-D Series.
- C. Quick Coupling Valves:
 - 1. Approved Products:
 - a. Rain Bird 44 RC.
- D. Master Valve: 24V AC, normally open .
 - Approved Products:
 - a. Size: 1.5 inch.
 - 1) Rain Bird EFB-CP-PRS-D brass master valve that is contamination-proof with self-flushing filter screen. Globe configuration and purple handle for non-potable designation. With pressure regulator.
- E. Flow Sensor: PVC tee type sensor.
 - 1. Approved Products:
 - a. Model No. FS150P by Rain Bird.
- F. Manual Drain Valve: Globe or angle brass manual valve with non-floating seat disk that allows positive drainage.
 - 1. Approved Products:
 - a. Manufactured by Arrowhead.
 - b. Nibco, Champion, or pre-approved equal.
- G. Drip Zone Control Valve:
 - 1. Approved Products:
 - a. As indicated on Drawings.

2.05 VALVE BOXES

1

- A. Valve box of suitable size with t-top type lid bolted closed.
 - 1. Black box and brown mulch lid in plant bed areas.
- B. Install valves in the following valve boxes:
 - 1. Control Valve Assembly: (2) Carson 1419-12.
 - 2. Control Valve Assembly: (2) Standard 12" Pentek, Ametek, or pre-approved equal.
 - 3. Quick Coupling Valves: Carson 910-18, T-Lid.
 - 4. Manual Drain Valves: 10" round Pentek, Ametek, or pre-approved equal.
 - 5. Manual Drain Valves: Carson 910-18.
 - 6. Isolation Valves: Carson 910-18.
 - 7. Traffic Rated Box: Brooks, No.37 MB Body, No. 37 T Cast Iron Cover.

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- 8. Other Valves: Sized as applicable by Pentek, Ametek, or pre-approval equal.
- 9. Other Valves: Sized as applicable by Carson.

2.06 IRRIGATION HEADS

A. Makes and models shown on Drawings, or approved.

2.07 WIRE

- A. Zone Control Wire (2-Wire):
 - 1. Approved products:
 - a. Zone Control Wire (2-Wire) Rainbird System: 14 AWG Paige Electric, Model # P7072D-REV17, or equal. Install according to manufacturer's wire schedule for valve specifications.
- B. Surge Protection:
 - 1. LSP 1 Line Surge Protector by Rain Bird.
- C. Wire Connections:
 - 1. Zone Control Wires: Direct bury splice Kit.
 - a. WC20 Wire Connectors by Rainbird.
 - Communication Wire: Splice is only allowed at the termination to connect to flow sensor.
 uR-2 butt splice kit 034005, or pre-approved equal.
- D. Utility Locate Wire: 14 gauge minimum, type AWG-UF, bearing U.S. approval, blue in color.

2.08 IRRIGATION CONTROLLER

- A. Commercial Series ESP-L D 50 station, two-wire decoder irrigation controller by Rain Bird.
- B. Cabinet mounted control assembly on exterior pedistal.
 - 1. Manufacturer: Rain Bird
 - 2. Enclosure: Stainless steel.
 - 3. Model number: L MMSSPED

2.09 CONTROLLER DECODERS

- A. All decoders shall be per the controller manufacturer's specifications.
- B. FD-TURF 2-Wire Decoders by Rain Bird, model as recommended by manufacturer.

2.10 BACKFILL MATERIALS

- A. Pea Gravel: 3/4 x 1/2 inch washed round rock.
- B. Sand: Clean, fill sand free of clay, rocks, organic matter, or other deleterious material.
- C. Topsoil or Loam: See Section 32 91 19 Landscape Grading.

PART 3 EXECUTION

3.01 PROTECTION

- A. Protect existing improvements and growth in areas to remain undisturbed until completion of project. Leave area in similar condition as found.
- B. Protect existing water service. Do not interrupt water service to facilities occupied by Owner or others or existing irrigation zones not impacted by construction unless permitted by Owner and only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Owner or Owner's Representative no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not proceed with interruption of water service without written approval from Owner or Owner's Representative.
- C. Protect utilities and maintain in continuous operation or in operational condition during work. Repair damage to known utilities at Contractor's expense.
- D. Use means necessary to protect materials of this Section before, during, and after installation and to protect installed Work and materials of other trades. In the event of damage immediately make repairs and replacements as directed by Architect.

3.02 EXAMINATION

- A. Verify that required utilities and sleeves are available, in proper location, and ready for use. Verify location, type, size, PSI, and GPM of existing water lines, meters, and sleeves.
- B. Verify that surfaces and structures to receive Work are accurately sized and located, sound, secure, true, complete, and otherwise properly prepared.
- C. Verify electrical service and conduit for Irrigation Controller is properly sized and located.

3.03 PREPARATION

- A. System layout is diagrammatic. Route piping to avoid plants, ground cover, and structures. If field measurements differ slightly from Drawings modify work for accurate fit. If measurements differ substantially notify Architect prior to installation.
- B. Review layout requirements with other affected work. Coordinate locations of sleeves under paving to accommodate system and piping to minimize conflict with other work.
- C. Coordinate connections to existing irrigation system, including system shut down, new connections, system re-start, and scheduling of new irrigation zone run times with Architect.
- D. Irrigation Head Layout Review:
 - 1. Install flags at locations of irrigation heads and components shown on Drawings. Obtain Architect's approval and make adjustments to locations as directed. Coordinate marking of pipe trenches and location of valves prior to executing Work.

3.04 CUTTING OF PAVEMENT AND REPAIR

A. Do not cut pavement for installation of Work without Architect's approval.

3.05 MASTER VALVE AND FLOW SENSOR INSTALLATION

A. Install where shown on drawings in accordance with manufacturer's directions when making supply and irrigation control component connections.

3.06 TRENCHING

- A. Excavating, trenching, and backfilling are specified in Section 32 91 19 Landscape Grading.
- B. Excavate trenches with uniform bottom and remove rocks and sharp objects to provide firm, even, clean base for pipe. Width of trench to be 1.5 times the outside diameter of the pipe.
- C. Trench Depth:
 - 1. Minimum cover over Installed Mainline Piping: 18 inches.
 - 2. Minimum cover over Installed Lateral Line Piping: 12 inches.
 - 3. Minimum cover over Installed Sleeves in Roadway: 24 inches.
 - 4. Minimum cover over Installed Sleeves at other paving: 6 inches from bottom of paving.
- D. More than one pipe is permitted in the same trench provided that:
 - 1. Two pipes may be stacked vertically if 4 inches of Sand separates them.
 - 2. Three or more pipes must be laid 4 inches apart horizontally.
- E. Where excavation is performed to excess levels backfill with specified soil material to proper levels.
- F. Keep trenches dry and frost free. Provide and operate pumping equipment to keep excavations free from standing water.
- G. All trenches and other disturbed area shall be free from heaving and/or settling by more than half inch. If necessary adjust grade, re-grade the trench and re-seed.
- H. Protect existing vegetation to remain. Cut no roots over two inches in diameter without approval of Architect. Make clean cuts, straight, at right angles to roots. Paint cuts over 1-1/2 inches diameter with approved tree paint. Repair or replace damaged plant material.

3.07 SLEEVE INSTALLATION

A. Sleeves may be jacked or pulled but cover requirements must be maintained. Jacking of PVC pipe is not permitted in rocky or bar run fills where there is potential for damage to pipes.

- B. Extend sleeves 12 inches beyond pavement edge or curb. Cover pipe ends and mark with stakes.
- C. Install level and perpendicular to sidewalks and pavement unless shown otherwise on drawings.
- D. Provide markers where sleeve ends are concealed.

3.08 PIPE BEDDING

- A. Mainline: Provide uniform bearing surface of Sand, 4 inches minimum depth, free of rocks and sharp objects under entire length of pipe.
- B. Lateral Line: Provide uniform bearing surface of clean topsoil, loam, or sand. If rock or other deleterious materials are encountered bed pipe with 4 inches of Sand on all sides.

3.09 PIPE INSTALLATION

- A. Irrigation lines may be jacked or pulled but cover requirements must be maintained. Jacking of PVC pipe is not permitted in rocky fill or where there is other potential damage to pipes.
- B. Install pipe in accordance with manufacturer's instructions and with the following minimum clearances around pipe:
 - 1. 2 inch diameter and smaller: 2 inches
 - 2. 2-1/2 inch diameter and larger: 4 inches
 - 3. Between irrigation and other utilities: 12 inches
- C. Threaded Plastic Pipe Installation:
 - 1. Do not use solvent cement on joints.
 - 2. Wrap threaded joints with teflon tape. Minimum 4 wraps of tape.
- D. Cemented Plastic Pipe Installation:
 - 1. Cut ends square using approved pipe cutter and bevel cuts with deburring tool.
 - 2. Clean pipe of scale, sand, dirt, etc. prior to assembling.
 - 3. No excess primer shall be used on joints.
 - 4. Wipe off excess cement continuously as it appears on the surface of the pipe after making joints.
 - 5. Allow fifteen minutes of cure time on joints before moving or handling. Assemble pipe before lowering into trench.
 - 6. Snake lines to allow for contraction.
 - 7. Transition pipe sizes at fittings and not at bell end of pipes.
 - 8. Install thrust blocks at 90 degree corners and tees.

3.10 DRIP LINE PIPE INSTALLATION

- A. Drip Line Pipe:
 - 1. Snake tubing to allow for expansion and contraction.
 - 2. Install Drip line Stakes at manufacturer's recommended spacing. Adjust spacing as necessary for soil conditions. Maximum stake spacing is 5 feet on center.
 - 3. Cut ends square using approved cutter.
 - 4. Clean off drip line of scale, dirt, etc. prior to assembling.
 - 5. Insert pipe ends to full depth of fitting.
- B. PVC Manifold:
 - 1. Follow installation procedures for cemented plastic pipe for PVC to PVC connections.
 - 2. Install Loc Adapters at each PVC Manifold to align with drip line shown on drawings.
 - 3. Follow manufacturer's recommendations for connections to PVC to Loc Adapters and for Loc Adapter to Drip line.

3.11 THRUST BLOCK INSTALLATION

- A. Install 2500psi thrust block at pipe corners, tees, ells, and stub outs as follows:
 - 1. Pipe 2 3 inches in diameter: 1 cubic foot.
 - 2. Pipe larger than 3 inches in diameter: 2 cubic feet.

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3.12 VALVE INSTALLATION

- A. Install plumb and square, as detailed, and according to manufacturer's specifications.
- B. Manual Drain Valves:
 - 1. Install at mainline low points and at outlet of control valves where laterals run uphill.
 - 2. Record locations on as-built drawings.
- C. Install 1 valve in each valve box assembly.
- D. Valve Sump: Install a minimum of 2 cubic feet of pea gravel below each valve. Allow for 4 inches clearance between bottom of valve and valve sump.

3.13 VALVE BOX INSTALLATION

- A. Install plumb and square with adjacent construction with one valve in each valve box assembly.
- B. At Control Valve Assemblies bolt two valve boxes together as detailed.
- C. Permanently label valve type and zone number on inside of valve box lid.
- D. Set top of valve boxes flush with lawn or mulch at plant beds unless otherwise noted.
- E. Provide support via bricks on each side of valve box as detailed.

3.14 CONTROL WIRE INSTALLATION

- A. Install wire in continuous runs with no splices, unless approved. Notify Architect for approval prior if splices are required and locate in valve box. Mark wire runs and location of splices on Project Record (as-built) Drawings.
- B. All splices will use 3M DBR/ gel filled splices.
- C. Install wires below irrigation mainline with multiple wires bundled together at 5 foot maximum intervals.
- D. Use different colored wire for each branch of 2-Wire path.
- E. Provide 48 inches loop in wires at each valve where controls are connected and at 100 foot maximum intervals between. Coil wire around 1/2 inch rebar dowel inside of valve box.
- F. Make electrical joints waterproof using specified connectors. Enclose joints in valve boxes.
- G. Install and ground surge protection every 500 LF and at end of wire run.
- H. Install wires in conduit when run above grade or independent of the mainline.

3.15 COMMUNICATION WIRE INSTALLATION

A. Install continuous run of communication wire from Flow Sensor to Irrigation Controller. Follow same installation procedures as Control Wire Installation. Splicing of wire is not permitted.

3.16 CONTROLLER INSTALLATION

A. Install controller in accordance with manufacturer's specifications and applicable codes. Connect to 120V power supply at location shown on drawings and approved by Architect.

3.17 MAINLINE PRESSURE TEST AND INSPECTION

- A. Field inspection and testing will be performed under provisions of Section 01 40 00 Quality Requirements.
- B. Prior to backfilling and installing valves test irrigation mainline for leakage. Establish and maintain 100 PSI pressure for 24 hours. Perform test a minimum of 24 hours after set-up of solvent weld. Notify Architect a minimum of 24 hours for review of pressure gauge at beginning and end of test period. Mainline will be accepted if pressure loss is less than 2 psi.
- C. Following the pressure test but prior to backfilling, notify Architect for review of pipe, fittings, joints, thrust blocks, bedding, control wire installation, valves, and other materials for installation and water tightness.
- D. After successful inspection of pressure test and mainline, begin backfilling and assembly of zones and system components.

E. Submit a written report of the pressure testing results with images and the other above required information to the Owner's Representative for approval.

3.18 BACKFILLING

- A. Remove debris, sharp rocks, and decayable matter from areas to be back filled before proceeding.
- B. Mainlines: Provide 6 inches sand cover over piping then place Utility Locate Wire the entire length of pipes where control wires are not present. Backfill remainder of trench with topsoil or loam.
- C. Lateral Lines: Backfill trench with topsoil or loam. Protect piping from displacement.
- D. At Paved Areas: Backfill trench with sand under paved areas.
- E. Compact backfill in 6 inch lifts to match density of surrounding material. Install backfill to match adjacent elevations.

3.19 FLUSHING

- A. Mainline: Open valves and thoroughly flush piping system under full water head after piping, risers, and valves are installed. Flush for 3 minutes before replacing flush cap. Close valves and cap risers immediately after flushing.
- B. Second Flushing: Flush a second time after installation of lateral lines and sprinklers prior to nozzle installation. Flush under full water head for three minutes. Install nozzles after flushing.
- C. Drip Line Flushing: Remove flush cap and flush each zone under full water head after all connections have been made. Maintain flushing for three minutes and immediately replace flush cap.

3.20 SPRINKLER HEAD INSTALLATION

- A. Install plumb with top of Topsoil/Loam or Mulch as detailed and at locations shown on drawings. Allow a maximum of 3 inches clearance between sprinkler head and adjacent lawn or planting edge.
- B. Install 1 cubic foot pea gravel sump on all low irrigation heads where drainage occurs at zone shutdown.

3.21 CONTROLLER PROGRAMING

- A. Prior to the beginning of the maintenance period the controller shall be programmed by the Contractor and approved by the Owner's Representative.
- B. Assign correct date and time to controller.
- C. Connect hydrometer or flow sensor and master valve wires in the controller to the assigned ports.
 - 1. If the irrigation system is 2-wire, assign the respective decoders for the hydrometer or flow sensor/master valve to the water source.
- D. Connect remote control irrigation valve wires to the assigned ports in the controller.
 - 1. If the irrigation system is 2-wire, assign the respective decoders for each valve to the zone number you want the valve to operate under.
- E. Group similar valves to the same program.
 - 1. For instance all of the tree valves are assigned to one program, all of the shrubs are assigned to a second program, and all of the turf valves are assigned to a 3rd program.
 - 2. Label each valve and give a brief description and location.
 - 3. Label each program and give a brief description of what it operates.
- F. Learn the flow for each valve in the controller.
 - 1. Contractor shall verify the K factor for each flow meter/hydrometer based upon the make and model of the flow equipment and controller along with the flow/hydrometer size.
- G. Establish system parameters for how the controller is to operate when detecting an errors, such parameters shall include but are not limited to:

- 1. High flow alerts.
- 2. Low flow alerts.
- 3. Unexpected flows.
- 4. Flow variance.
- H. If applicable, Contractor shall connect the controller to the cloud for online access through a computer, smart phone, or tablet.
 - 1. An online account shall be created for the Owner, Owner's Representative and installing Contractor.
 - 2. All accounts shall have email notifications set up which alerts the users of errors and program stats.
- I. Contractor and Owner's Representative shall observe the site one day after controller operation though programing to verify system operation and no water run-off has occurred or breaks were present.

3.22 AD USTMENT AND COVERAGE TEST

- A. Adjustment:
 - 1. The Contractor shall flush and adjust all sprinkler heads, valves and other equipment to ascertain that they are functioning according to the manufacturer's data.
 - 2. Adjust all sprinkler heads not to overspray onto walks, roadways and buildings when under maximum operating pressure and during times of normal prevailing winds.
- B. Coverage test:
 - 1. The Contractor shall perform the coverage test in the presence of the Owner's Representative after all sprinkler heads have been installed, flushed and adjusted. Each section is tested to demonstrate uniform and adequate coverage of the planting areas serviced.
 - 2. Any systems that require adjustments for full and even coverage shall be done by the Contractor prior to final acceptance at the direction of the Owner's Representative at no additional cost. Adjustments may also include realignment of pipes, addition of extra heads, and changes in nozzle type or size.
 - 3. The Contractor at no additional cost shall immediately correct all unauthorized changes or improper installation practices.

3.23 SUBSTANTIAL COMPLETION REVIEW

- A. When Work of this Section is complete, notify Architect for Substantial Completion Review.
- B. Prior to notifying Architect prepare and start system in accordance with manufacturer's instructions, review zones, and make adjustments to ensure full and even coverage.
- C. Adjust system for full water coverage as directed.

3.24 SYSTEM DEMONSTRATION TO OWNER

A. Instruct Owner in operation and maintenance of system, including adjusting of sprinkler heads. Use operation and maintenance data as basis for demonstration.

3.25 CLEANING

A. Remove excess excavation, backfill materials, and other left over materials from the site. Clean improvements soiled by work of this Section.

3.26 FINAL COMPLETION REVIEW

A. Notify Architect for Final Completion Review.

SECTION 32 91 19 LANDSCAPE GRADING LANDSCAPE GRADING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preparation of subgrade at lawn and landscape areas.
- B. Soil placement and preparation at lawn and landscape areas.
- C. Finish grading.

1.02 RELATED REQUIREMENTS

- A. Section 01 56 39 Temporary Tree and Plant Protection.
- B. Section 01 60 00 Product Requirements
- C. Section 32 93 00 Plants.

1.03 DEFINITIONS

- A. Weeds: Any plant life not specified or scheduled. Includes seeds and roots.
- B. Subgrade: The top of undisturbed soil or compacted fill material located below planting soils for landscapes.
- C. Landscape Areas: Defined as areas not covered by hardscape or buildings.

1.04 ACTION SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements for submittal procedures.
- B. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients. Provide mark ups using red ink.
- C. Submit a 2 quart sample of Imported Soil Material with supplier's name and specific location of source. Approval of Soil Material by Owner's Representative is required prior to delivery to the site.
- D. Submit analysis of Soil Material indicating USDA classification, macro and micro nutrients, organic matter, and recommendations for amendments.

1.05 REVIEWS

- A. Request the following reviews by the Owner's Representative 2 days in advance. Coordinate all reviews to coincide with regular progress meetings where possible.
 - 1. Subgrade preparation.
 - 2. Soil Material placement.
 - 3. Organic Material placement.
 - 4. Finish grading.

PART 2 PRODUCTS

2.01 SOIL MATERIALS

- A. Premixed Planting Soil: For use at landscape plant bed areas.
 - 1. Premixed Planting Soil: Blended, organic soil mix composed of loam, sand, and compost. a. Approved Products:
 - 1) Pro Mix Planting Soil by Rexius, Eugene, Oregon, or approved.
 - 2) Primary Planting Soil by Rexius, Eugene, Oregon.
 - 3) Frugal Planting Soil by Lane Forest Products, Eugene, Oregon.
 - 2. Substitutions: See Section 01 60 00 Product Requirements.

2.02 SOIL AMENDMENT MATERIALS

A. Lawn Installation Fertilizer: Uniform composition, dry, and free flowing of proportion necessary to eliminate any deficiencies of topsoil, to the following proportions:.

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- 1. Nitrogen: 16 percent. (source of Nitrogen to be methyl-urea based)
- 2. Phosphoric Acid: 16 percent.
- 3. Soluble Potash: 16 percent.
- 4. Do not use within 50 feet of water.
- B. Organic Material: 100% organic materials following guidelines and tested to meet the US Composting Council's seal of testing assurance.
 - 1. Garden Compost by Rexius, Eugene, Oregon.
 - 2. Garden Compost by Lane Forest Products, Eugene, Oregon.
 - 3. Substitutions: See Section 01 60 00 Product Requirements.

2.03 DRAIN ROCK

A. 3/8 inch washed round rock free of fines.

2.04 HERBICIDE

- A. Broad Spectrum Non-Selective: Buccaneer Plus, or approved.
- B. Selective for Broadleaves: Speed Zone, Weed-B-Gone, or approved.
- C. Selective for Grasses: Envoy or approved.

2.05 ACCESSORIES

2.06 SOURCE QUALITY CONTROL

- A. Provide analysis of Soil Material indicating source of material, USDA classification, macro and micro nutrients, and organic matter.
- B. Submit required sample of Soil Material to testing agency for analysis. Submit test results to Owner's Representative.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.
- B. Verify that materials and surfaces to receive work specified herein are accurately sized, shaped, and located; sound, secure, true, complete, and otherwise properly prepared.
- C. Verify subgrades produce positive drainage and allow for placement of Soil Material, Ammendments, and Mulch to specified depths.

3.02 PROTECTION

- A. Locate, identify, and protect from damage above- and below-grade utilities to remain. Protect utilities and maintain in continuous operation or in operational condition during work. Repair damage to known utilities or related facilities in an approved manner at Contractor's expense.
- B. Protect site features to remain, including but not limited to bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs, from damage by grading equipment and vehicular traffic.
- C. Verify tree protection fencing is in place.
- D. Protect plants, lawns, rock outcroppings, and other features to remain as a portion of final landscaping.
- E. Protect drainage inlets and underground drain lines from infiltration or clogging by soils and mulch during construction until Final Completion.
- F. Protect areas designated for stormwater treatment. Fence areas planned for stormwater treatment. There should be no compaction of existing soils in areas planned for stormwater treatment.

3.03 SUBGRADE PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Stake and flag locations of known utilities.

- C. Prepare subsoil to eliminate uneven areas or low spots. Maintain profiles and contours. Make changes in grade gradual. Blend slopes into level areas.
- D. Remove foreign materials, weeds and undesirable plants and their roots, stones and rocks up to 1/2 inch diameter, and dirt clods. Remove contaminated subsoil.
- E. Scarify subsoil to a depth of 6 inches where plants are to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted subsoil.
- F. Verify subgrades, whether comprised of subgrade soil or fill drain freely. Test area by flooding with Owner's Representative present. Where water does not drain freely auger a 10 inch hole, minimum 1 per 1,000 square feet, through fill material and into subsoil, or maximum 4 feet deep into subsoil to establish positive drainage. Fill with Drain Rock to subgrade.
- G. Verify subgrades allow for placement of Soil Material, Amendments, and Mulch to depths specified.
- H. Notify Owner's Representative for review of subgrade prior to placing Soil Material.

3.04 PLACING SOIL MATERIAL

- A. Soil Material Placement Schedule:
 - 1. At Plant Beds: 18 inches minimum depth.
 - 2. Place additional Soil Material as required to establish finish grades shown on drawings and to fill in depressions, blend grades, and produce positive drainage.
- B. Place Soil Material during dry weather and on dry unfrozen subgrade. Suspend Soil Material placement if subgrade or Soil Material become saturated.
- C. Phase Soil Material placement so that equipment does not travel over Soil Material already installed. Equipment travel over placed soil materials is prohibited.
- D. Notify Owner's Representative for Soil Material placement review prior to proceeding with Work.

3.05 INITIAL WEED CONTROL

- A. Inspect lawn and landscape areas for the presence of weeds. If weeds are present apply broad spectrum herbicide.
- B. Inspect lawn and landscape areas for the presence of weeds. If weeds are present manually remove.
- C. During herbicide application ensure safety and environmental precautions are taken and best management practices are employed. Adjust procedures adjacent to waterways.

3.06 SOIL PREPARATION AND FINISH GRADING

- A. Remove debris, sticks, roots, clods, stones and rocks greater than 1/2 inch diameter, and soils contaminated by petroleum products at landscape and lawn areas. Rake smooth, eliminate uneven areas or low spots in Soil Material, and set grades for positive drainage.
- B. At plant beds:
 - 1. Manually remove weeds as described in Initial Weed Control.
 - 2. Spread 3 inches Organic Material over entire plant bed. Organic Material must be incorporated immediately into plant beds, no stock piling is permitted.
 - 3. Notify Owner's Representative for Organic Material placement review prior to proceeding with tilling and planting.
 - 4. Thoroughly rototill Organic Material into the top 6 inches of Soil Material, except within 10 feet of existing trees and Tree Protection zones.
 - 5. Rake smooth and reset finish grades eliminating uneven or low spots in plant beds and setting grades for positive drainage. Ensure grades at edges of plant beds allow for placement of Mulch Material to specified depths and as detailed.
- C. At trees:
 - 1. Thoroughly mix 5 parts Soil Material and 1 part Organic Material for backfilling trees.
- D. Notify Owner's Representative for Finish Grading Review prior to proceeding with Work.

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3.07 SECOND WEED CONTROL

- A. After completion of Soil Preparation and finish grading commence irrigation of all lawn and landscape areas. If weeds are present apply broad spectrum herbicide.
- B. Wait ten days minimum and inspect all landscape and lawn areas for the presence of any additional weeds. If weeds are present, apply a second application of Herbicide to affected areas and delay planting until all weeds are dead.
- C. Inspect lawn and landscape areas a minimum of every 30 days for the presence of weeds. If weeds are present remove weeds.
- D. During herbicide application ensure safety and environmental precautions are taken and best management practices are employed. Adjust procedures adjacent to waterways.

3.08 TOLERANCES

- A. Top Surface of Subgrade: Plus or minus 0.08 foot (1 inch) from required elevation.
- B. Top Surface of Finish Grade: Plus or minus 0.04 foot (1/2 inch).

3.09 REPAIR AND RESTORATION

- A. Existing Facilities, Utilities, and Site Features to Remain: If damaged due to this work, repair or replace to original condition.
- B. Other Existing Vegetation to Remain: If damaged due to this work, replace with vegetation of equivalent species and size.

3.10 CLEANING

A. Leave site clean and raked, ready to receive landscape planting and seeding.

SECTION 32 93 00 PLANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Locate, purchase, deliver, and install plants.
- B. Mulch and Fertilizer, Stake, and Prune as specified.
- C. Maintenance.
- D. Warranty.
- E. Tree Pruning.

1.02 RELATED REQUIREMENTS

- A. Section 01 60 00 Product Requirements
- B. Section 01 70 00 Execution and Closeout Requirements
- C. Section 32 80 00 Irrigation
- D. Section 32 91 19 Landscape Grading

1.03 DEFINITIONS

- A. Weeds: Any plant life not specified or scheduled. Includes seeds and roots.
- B. Plants: Living trees, plants, and ground cover specified in this Section, and described in ANSI Z60.1.

1.04 REFERENCE STANDARDS

A. ANSI/ANLA Z60.1 - American Standard for Nursery Stock; 2004.

1.05 ACTION SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
- B. Submit list of plant life sources.
 - 1. Submit confirmation from supplier(s) that specified plant materials, meeting the specifications, have been secured.
 - 2. Include plant name, quantity, size, condition, and name of supplier.
- C. Product Data: Submit manufacturer's printed data for products and a list of suppliers.

1.06 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Include written instructions covering yearly recommended maintenance and care of plantings including fertilization, pest and disease control, weed control, mulching, and pruning.
- B. Record Drawings: Submit project record (as-built) drawings to Owner's Representative prior to Final Completion Review.
 - 1. Keep one complete set of contract documents as Project Documents. Keep documents current. Do not permanently cover work until as-built information is recorded.
 - 2. Use white-out and red ink to legibly re-draft actual locations of installed work.
 - 3. Submit to Architect for approval.
 - 4. Completion of the Record Drawings will be a prerequisite for the Final Completion Review.

1.07 QUALITY ASSURANCE

- A. Valid Oregon Landscape Contractor's license.
- B. Valid Oregon Landscape Business license.
- C. Herbicide applicators must have valid State of Oregon Herbicide Applicator's license.
- D. Installer Qualifications: Company specializing in installing and planting the plants with 5 projects of comparable scale successfully completed.

1. Submit names, addresses, and dates of previous projects, owners, and locations if requested by Owner's Representative.

1.08 PLANT SUBSTITUTIONS FOR PLANTS NOT AVAILABLE

A. A. Submit all requests for substitutions of plant species, or size to the Owner's Representative, for approval, prior to purchasing the proposed substitution. Request for substitution shall be accompanied with a list of nurseries contacted in the search for the required plant and a record of other attempts to locate the required material. Requests shall also include sources of plants found that may be of a smaller or larger size, or a different shape or habit than specified, or plants of the same genus and species but different cultivar origin, or which may otherwise not meet the requirements of the specifications, but which may be available for substitution.

1.09 COORDINATION

- A. Coordinate with other trades affecting and affected by Work of this Section.
- B. Pre-Installation Conference: Attend conference to coordinate Work of this Section and other related Sections.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.
- B. Protect and maintain plant life until planted.
- C. Deliver plant life materials immediately prior to placement. Keep plants moist.
- D. Deliver products in original unopened packaging with legible manufacturer's identification.
- E. Plants may be rejected if:
 - 1. Ball of earth surrounding roots has been dried out, cracked, or broken.
 - 2. Burlap, staves, wire baskets, or ropes required in connection with transplanting have been displaced.
 - 3. Grower or nursery identification labels have been displaced prior to Plant Materials Review.

1.11 ENVIRONMENTAL CONDITIONS

- A. Do not install plant life when ambient temperatures are below 32 degrees F or above 90 degrees F.
- B. Do not install plant life when wind velocity exceeds 30 mph.
- C. Do not install plant life when soil becomes saturated.
- D. Install plant materials _during periods which are normal for such work as determined by the following:
 - 1. Biological season
 - 2. Specified environmental conditions
 - 3. Accepted practice
 - 4. After all major construction work has been completed
- E. Planting Seasons:
 - 1. Trees: Bare root trees may be planted only between January 15th and March 15th unless otherwise approved.
 - 2. Other: Permitted during any period, except when prohibited by other portions of this Section.

1.12 SELECTION AND OBSERVATION OF PLANTS

A. The Owner's Representative may review all plants subject to approval of size, health, quality, character, etc. Review or approval of any plant during the process of selection, delivery, installation and establishment period shall not prevent that plant from later rejection in the event that the plant quality changes or previously existing defects become apparent that were not observed.

- B. Plant Selection: The Owner's Representative reserves the right to select and observe all plants at the nursery prior to delivery and to reject plants that do not meet specifications.
- C. All plants that are rejected shall be immediately removed from the site and acceptable replacement plants provided at no cost to the Owner.

1.13 REVIEWS

- A. Request the following reviews by the Owner's Representative 2 days in advance:
 - 1. Accent Stone Mock-up Review
 - 2. Accent Stone Placement Review
 - 3. River Rock Mock-up Review
 - 4. Plant Materials Review
 - 5. Planting Mock-up Review
 - 6. Substantial Completion Review
 - 7. Final Completion Review
- B. See Part 3 Execution for review requirements.
- C. Coordinate all reviews to coincide with regular progress meetings where possible.

1.14 WARRANTY

- A. See Section 01 78 00 Closeout Submittals, for additional warranty requirements.
- B. Provide one year warranty following Final Completion or one full growing season following Final Completion, whichever is later.
- C. Replacements: Plants of same size and species as specified, planted in the next growing season, with a new warranty commencing on date of replacement.
- D. At the end of the warranty period, as directed by Owner's Representative and at no additional cost to the Owner
 - 1. Replace work not surviving, in poor condition, or not exhibiting satisfactory growth.
 - 2. Reset plant materials and stones which have settled or become un-set
 - 3. Replace plant materials which appear to be a different species or variety than specified.
 - 4. Provide noxious weed eradication from imported Soil Material, if required and as specified herein.
 - 5. Complete warranty work within 30 days of warranty review.
- E. Contractor is not responsible for plant loss or damage to work during warranty period which is caused by unusually extreme weather, vandalism, or Owner's lack of maintenance.

PART 2 PRODUCTS

2.01 PLANTS

- A. Plants: Species and size identified in plant schedule, grown in climatic conditions similar to those in locality of the work.
- B. General:
 - 1. Sizes, grades, and conditions are listed on Plant List. Quantities are shown for Contractor's convenience. Contract is responsible for providing plants drawn on drawings.
 - 2. Cold storage stock unacceptable.
 - 3. Free of disease, decay, injury, and insects.
 - 4. Full foliaged when in leaf.
 - 5. Furnish Balled and Burlapped (B&B) stock with solid, properly wrapped and secured, natural ball. Stock 2 inch caliper and up to be transported and handled with root ball in wire basket.
 - 6. Furnish container stock with sufficient roots to insure healthy growth but not root bound. When plant is removed from container soil must hold together and roots must be visible but not encircling.
 - 7. Free from Weeds.
 - 8. Field grown trees and shrubs must have been transplanted or root pruned at least once no more than two years prior to this Contract.

- 9. Container stock may be substituted for Balled and Burlapped (B&B) or Bare Root (BR) stock at any time.
- 10. Container or B&B stock must be substituted for BR stock if installation season prohibits use of BR stock.
- C. Trees shall have:
 - 1. Single, straight, uniformly tapering trunks which are perpendicular to the ground, unless specified as multi-stemmed or otherwise on Plant List. Trees with co-dominant, damaged, crooked, or topped leaders will be rejected.
 - 2. Healthy and vigorous overall condition.
 - 3. Full and even branch distribution; structural scaffold branches at least 4 inches apart where they attach to the main trunk.
 - 4. Well-developed root systems. Trees with more than 2 inches of root ball soil covering root flare will be rejected.
 - 5. Grafts near ground level.
 - 6. Minimum/maximum branching heights above the ground unless specified otherwise on Plant List:
 - a. 2 inch caliper tree: 5' 7'
 - b. 1.5 inch caliper tree: 4' 6'
 - 7. Conifers shall also have full, even branching to ground level and intact single leader.
 - 8. Trees shall be free of:
 - a. Major structural defects including, but not limited to, branches with narrow angle of attachment (less than 40 degrees to the trunk), bark with major branch unions, and trees with co-dominant leaders.
 - b. Poor pruning practices including, but not limited to, stubbed branches and topped leader.
 - c. Damage to the trunk, branches, and root system including, but not limited to, bark abrasions, sun scald, and disfiguring knots.
 - 9. Trees shall be freshly dug during the most recent favorable harvest season.

2.02 SOIL AMENDMENT MATERIALS

- A. Plant Bed Maintenance Fertilizer:
 - 1. Approved Products:
 - a. Be-1 Organic Pellets (with 3-6-5 chemical analysis).
 - b. Down to Earth All-Purpose Fertilizer (with 4-6-2 chemical analysis).
 - c. Jobes Organic All Purpose Granular Fertilizer (with 4-4-4 chemical analysis).
 - 2. Substitutions: See Section 01 60 00 Product Requirements.
 - 3. Do not use within 50 feet of water.
 - B. Planting Tablets:
 - 1. Biofertilizer Planting Tablets (with 12-8-8 chemical analysis).
 - 2. Healthy Start Macro Tablets (with 12-8-8 chemical analysis).
 - 3. Substitutions: See Section 01 60 00 Product Requirements.
- C. Mycorrhizal Fungi:
 - 1. All Purpose Granular MycoApply by Mycorrhizal Applications Inc, Grants Pass, Oregon (541-476-3985).
 - 2. Substitutions: See Section 01 60 00 Product Requirements.
- D. Water: Clean, fresh, and free of substances or matter that could inhibit vigorous growth of plants.
- E. Organic Material: 100% organic materials following guidelines and tested to meet the US Composting Council's seal of testing assurance.
 - 1. Products: Garden Compost by Rexius, Eugene, Oregon.
 - 2. Substitutions: See Section 01 60 00 Product Requirements.

2.03 MULCH MATERIALS

- A. Mulch Material at Plant Beds: Hemlock species wood shavings, free of growth or weeds, "sliver free".
 - 1. Approved Products:
 - a. Premium Hemlock Bark from Rexius, Eugene, Oregon.
 - b. Hemlock Bark from Lane Forest Products, Eugene, Oregon.
 - 2. Substitutions: See Section 01 60 00 Product Requirements.

2.04 HERBICIDE

- A. Broad Spectrum Non-Selective: Buccaneer Plus, or approved.
- B. Selective for Broadleaves: Speed Zone, Weed-B-Gone, or approved.
- C. Selective for Grasses: Envoy or approved.

2.05 ACCESSORIES

- A. Wrapping Materials: Burlap.
- B. Stakes: 2 x 2 inch x 8 feet wood stakes, capable of at least 2 years ground burial, stained charcoal or black.
- C. Tree Ties: Chain lock tree ties, 1 inch wide, or approved.

2.06 ACCENT STONES

A. Basalt stones in 3 distinct sizes:

	<u>Length</u>	<u>Width</u>	<u>Height</u>
Large	36-42 inches	24-30 inches	18-24 inches
Medium	24-30 inches	18-24 inches	12-18 inches
Small	18-24 inches	14-18 inches	10-14 inches

- B. Provide stones from a single source.
- C. Provide boulders from a single source in Southern Oregon. Provide color photo indicating sample of six boulders of assorted colors within size ranges indicated. Provide photo for approval prior to ordering in quantity. Approved colors will be the standard for acceptance of color range.
- D. Boulders shall have visible moss or lichen and weathered patina on at least two sides intended to be exposed. Note placement requirements in Part 3 when selecting stones.

2.07 STONE SPLASH BLOCK

- A. Basalt slab, between 4-7" in thickness, between 18-24" in width and length. Stone with uneven surface and unique patina is preferred.
- B. Provide boulders from a single source in Southern Oregon. Provide color photo indicating sample of six boulders of assorted colors within size ranges indicated. Provide photo for approval prior to ordering in quantity. Approved colors will be the standard for acceptance of color range.

2.08 BASALT COLUMN

- A. Basalt column with minimum dimension of 12" diameter x 15 inches tall.
- B. Top of column shall have a concave form, and slightly pitched surface that drains toward the other stones and boulders. Minimal water shall remain in "dished" top of column.
- C. This column shall be taller than the other stones and boulders around it.
- D. Provide columns from a single source in Southern Oregon or Willamette Valley. Provide color photo indicating sample of six boulders of assorted colors within size ranges indicated. Provide photo for approval prior to ordering in quantity. Approved colors will be the standard for acceptance of color range.

2.09 RIVER ROCK

A. River rock of 3 distinct sizes:

Large	8-12 inches
Medium	6-8 inches
Small	3-5 inches

B. Provide boulders from a single source in Southern Oregon. Provide color photo indicating sample of six boulders of assorted colors within size ranges indicated. Provide photo for approval prior to ordering in quantity. Approved colors will be the standard for acceptance of color range.

2.10 DRAIN ROCK

A. 3/8 inch washed round rock free of fines.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Prior to installation of Work of this Section, carefully inspect the work of others and verify that such work is complete to the point where this installation may properly commence.
- B. Verify weed control measures have taken place and soil is free of weeds and ungerminated weed seeds.
- C. Verify that materials and surfaces to receive work specified herein are accurately sized, shaped, and located; sound, secure, true, complete, and otherwise properly prepared.
- D. Verify Soil Material has been placed to specified depths and allow for placement of Soil Amendments and Mulch to specified depths.
- E. Do not install Work of this Section until all unsatisfactory conditions have been corrected. Beginning Work of this Section signifies acceptance of existing conditions.
- F. Verify that required underground utilities are available, in proper location, and ready for use.

3.02 PROTECTION

- A. Protect existing improvements and growth in areas to remain undisturbed until completion of project. Leave in similar condition as found.
- B. Maintain benchmarks, monuments, and other reference points. Replace if disturbed or destroyed.
- C. Contact local utility companies for verification of the location of underground utilities with the project area prior to starting excavation. Protect utilities and maintain in continuous operation or in operational condition during work. Repair damage to known utilities or related facilities in an approved manner at Contractor's expense.
- D. Protect all drainage inlets and underground drain lines from infiltration or clogging by soils and mulch during construction until Final Completion.
- E. Protect materials of this Section before, during, and after installation. Protect installed work and materials of other trades. In the event of damage immediately make repairs or replacements as directed by Owner's Representative.

3.03 ACCENT STONE PLACEMENT

- A. Install Accent Stones where shown on Plans. Make minor adjustments to accommodate irrigation, planting, and other site elements.
- B. Place Accent Stones after weirs have been installed and soil preparation and finish grading are complete, but prior to placement of river rock, plant materials, and mulch.
- C. Notify Owner's Representative at least 2 days prior to commencement of Accent Stone Placement.
- D. Accent Stone mock-up and stone layout review:

- 1. Owner's Representative will provide on-site aesthetic direction for stone placement to establish design intent. Acceptable mock-up represents expected quality level of the remaining stone installation and may remain as part of Work.
- 2. Stake locations of Large and Medium Stones, using irrigation flags of contrasting colors for each stone size.
- E. Install Accent Stones in the following sequence:
 - 1. Large
 - 2. Medium
 - 3. Small
- F. Nest Accent Stones into Soil Material as detailed. In general, stones should be installed based on the following, in order of importance:
 - 1. Horizontal rather than vertical
 - 2. Wider at the ground than at the top so the stone appears to grow out of the soil.
 - 3. Flatter surface on top.
- G. Notify Owner's Representative for review of Accent Stone Placement.

3.04 RIVER ROCK PLACEMENT

- A. River Rock mock-up:
 - 1. Install approximately 100 square foot section showing typical condition for review.
 - 2. Notify Owner's Representative for review of mock-up.
- B. Install River Rocks after Accent Stones are in place.
- C. Large and Medium River Rock:
 - 1. Scatter in a random fashion over remaining areas where rock is shown to be installed.
 - 2. Adjust rocks into horizontal positions, not vertical. Tamp into place.
 - 3. Notify Owner's Representative of progress and allow making adjustments.
- D. Small River Rock:
 - 1. Cover area where rock is shown to be installed. Tamp into place.

3.05 WEED CONTROL

A. Commence irrigation of all plant beds for 2 weeks prior to installing plant material. If weeds are present manually remove or apply broad spectrum herbicide.

3.06 INSTALLATION OF PLANT MATERIAL

- A. Plant Material Review:
 - 1. Notify Owner's Representative prior to the delivery of all trees and plant materials to the site but prior to installing plants. Owner's Representative will review quality of plant materials and reject plant materials not in compliance the Plant List and Specifications. This review is preliminary. Final approval of plants materials will not be given until Final Completion Review.
- B. Planting Mock-Up Review:
 - 1. Notify Owner's Representative prior to commencement of planting. Install an initial 500 square feet sample of typical plantings for review. Adjust planting procedure as directed.
- C. Tree Planting:
 - 1. Soak container grown, B&B, and BR plants before planting.
 - 2. Remove extra soil on top of root ball to expose flare of first buttress root. Root flare must be visible at top of root ball.
 - 3. Dig individual planting holes circular with vertical sides as shown on Planting Detail.
 - 4. Save and thoroughly loosen soil removed from planting hole and use as backfill around tree. Backfill trees with specified mixture if addition Soil Material is needed.
 - 5. Sprinkle mycorrhizal fungi to surface of planting holes at rate of 2-4 ounces per inch of stem caliper.
 - 6. Lift trees by wire basket only. Do not lift trees by trunk or use trunk as a lever to position or move tree.

- 7. Set B&B trees in the hole with the north marker facing north unless otherwise approved.
- 8. Set root crown as shown on Planting Detail not less than 3 inches above surrounding finish grade.
- 9. Cut and completely remove twine and other fasteners from root ball. Remove burlap from top half of root ball. Remove all burlap if not biodegradable. Neatly cut off broken or frayed roots.
- 10. Remove top half of wire basket after planting.
- 11. Where indicted on the drawings, apply a Tree Bark Protector to tree.
- 12. Stake trees as shown on Planting Detail.
- D. All other Plants:
 - 1. Soak container grown, B&B, and BR plants before planting.
 - 2. Dig individual planting holes with circular and with vertical sides 1-1/2 inch shallower than depth of root ball.
 - 3. Dig holes for pocket-planted shrubs 3 times the diameter of the rootball.
 - 4. Sprinkle mycorrhizal fungi to surface of planting holes at the following rates:
 - a. #SP4 container 1 tablespoon
 - b. #1 container 2 tablespoons
 - c. #3 container 3 tablespoons
 - d. #5 container 5 tablespoons
 - 5. Install Planting Tablet at shrubs and ground covers at manufacturer's recommended high rate.
 - 6. Cut circling roots with a sharp knife.
 - 7. Set root crowns 1-1/2 inch above surrounding grade and as detailed.
- E. Plants set too deeply will be rejected. Reset plants that have settled.
- F. Set plants plumb and for best appearance.
- G. Carefully tamp soil under and around root balls and bare roots to prevent settlement.
- H. Backfill pocket-planted plants with equal parts Soil Material and Organic Material.
- I. Flood hole when half backfilled and tamp soil between bare roots.
- J. Complete backfilling and tamp soil between bare roots.
- K. Thoroughly water each plant and entire bed immediately after planting.
- L. Remove all tags, labels, strings, etc. from plants.
- M. Prune Plant Material to remove dead, broken, or damaged branches.
- N. Rake plant beds smooth, resetting finish grades for positive drainage and eliminating uneven or low spots.

3.07 TREE PRUNING

- A. Pruning trees shall be limited to addressing structural defects.
- B. Perform pruning of trees as recommended in ANSI A300.
- C. Prune newly planted trees as required to remove dead, broken, and split branches.

3.08 MULCH INSTALLATION

- A. Install 3 inch minimum depth Mulch within 24 hours after planting at plant beds and trees as shown on drawings and details.
- B. Remove excess Mulch from foliage of plant materials and from bark of trees. Mulch must not be placed within 3 inches of tree trunks. Remove mulch from adjacent surfaces and produce edges shown on Details.

3.09 CLEANING

A. Remove excess materials from site. Protect drain inlets and underground piping as necessary and clean improvements soiled by Work of this Section.

3.10 MAINTENANCE PRIOR TO FINAL COMPLETION

- A. During period between installation and Final Completion:
 - 1. Water, fertilize, weed, reset unstable or disturbed plants, and perform other maintenance necessary to assure healthy growth.
 - 2. Install Plant Bed Maintenance Fertilizer at a rate of 6 lbs per 1000 square feet 45-60 days after installation. Adjust timing for seasonal requirements of plant materials.
 - 3. Thoroughly water immediately after applying Plant Bed Maintenance Fertilizer.
 - 4. Repair and regrade erosion damage.
 - 5. Provide continued weed control and removal until any weed problem is fully eradicated.

3.11 SUBSTANTIAL COMPLETION REVIEW

- A. When work of this Section is complete, notify Owner's Representative for Substantial Completion Review.
- B. Use specified materials to address items that do not comply with requirements and continue maintenance until Warranty is granted.
- C. Complete corrective work within 30 days and prior to Final Completion Review, or in a manner of time approved by Owner's Representative.

3.12 MAINTENANCE DURING WARRANTY PERIOD BY OTHERS

- A. After final completion, the Contractor shall make sufficient site visits to observe the Owner's maintenance and become aware of problems with the maintenance in time to request changes, until the date of the end of warranty period.
 - 1. Notify the Owner's Representative in writing if maintenance, including watering, is not sufficient to maintain plants in healthy condition. Such notification must be made in a timely period so that the Owner's Representative may take corrective action.
 - a. Notification must define the maintenance needs and describe any corrective action required.
 - 2. In the event that the Contractor fails to visit the site and notify, in writing, the Owner's Representative of maintenance needs, lack of maintenance shall not be used as grounds for voiding or modifying the provisions of the warranty.

3.13 FINAL COMPLETION REVIEW

- A. Notify Owner's Representative for Final Completion Review when corrective Work from the Substantial Completion review is complete.
- B. Failure to pass observation: If the work fails to pass final observation, any subsequent observations must be rescheduled as per above. The cost to the Owner for additional observations will be charged to the Contractor at the prevailing hourly rate of the Owner's Representative.

SECTION 32 3119 DECORATIVE METAL FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Decorative steel fences and gates.
- B. Vehicle gates.
- C. Automatic gate operators.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 Cast-in-Place Concrete.
- B. Section 08 7100 Door Hardware
- C. Division 26 & 27 Electrical and Communications

1.03 REFERENCE STANDARDS

- A. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- B. ASTM B221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- C. ASTM F2200 Standard Specification for Automated Vehicular Gate Construction; 2020.
- D. ASTM F2408 Standard Specification for Ornamental Fences Employing Galvanized Steel Tubular Pickets; 2016.
- E. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- F. NFPA 70 National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 50 Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 50E Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- I. UL 325 Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to start of work of this section; require attendance by affected installers.

1.05 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Submit 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.
- C. Shop Drawings Fence and Pedestrian Gates:
 - 1. Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.
- D. Shop Drawings Vehicle Gates:
 - 1. Layout and overall dimensions of each major element of the gate equipment, including the gate operator unit, operator control panels, and vehicle detection loops.
 - 2. Hydraulic schematic drawing showing size and number of hoses required to run between the barrier device and the hydraulic power unit.

- 3. Electrical schematic including associated wiring, showing electrically connected components, including interface points for connection to equipment; indicate minimum conduit size and number of wires required to run between each component of the barrier equipment.
- E. Manufacturer's Warranty.

1.06 WARRANTY

- A. See Section 01 7800 Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide 20 year manufacturer warranty for fences and gates material finish, , including cracking, peeling, chipping, blistering or corroding.
- D. Provide five year or 500,000 gate cycles manufacturer warranty for gate operators.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Decorative Metal Fences and Gates:
 - 1. Alumi-Guard; ____: www.alumi-guard.com/#sle.
 - 2. Ameristar Perimeter Security, USA; Montage II: www.ameristarfence.com/#sle.
 - 3. Substitutions: See Section 01 6000 Product Requirements.
- B. Automatic Gate Operators:
 - 1. Nice | HySecurity. www.hysecurity.com

2.02 FENCES

- A. Fences: Complete factory-fabricated system of posts and panels, accessories, fittings, and fasteners; finished with electrodeposition coating, and having the following performance characteristics:
- B. Electro-Deposition Coating: Multistage pretreatment/wash with zinc phosphate, followed by epoxy primer and acrylic topcoat.
 - 1. Total Coating Thickness: 2 mils, minimum.
 - 2. Color: As scheduled.
- C. Steel: ASTM A653/A653M; tensile strength 45,000 psi, minimum.
 - 1. Hot-dip galvanized; ASTM A653/A653M, G60.
 - 2. 62 percent recycled steel, minimum.

2.03 WELDED STEEL FENCE

- A. Provide fence meeting requirements for Industrial class as defined by ASTM F2408.
 - 1. Basis of Design: Ameristar Perimeter Security; Montage II
 - 2. Substitutions: See Section 01 6000 Product Requirements.
- B. Fence Panels: Fusion welded;
 - 1. Panel Style: Three rail.
 - 2. Typical perimeter fence:
 - a. Panel size: 6 feet high by 6 feet long.
 - b. Panel Style: Four rail.
 - 3. Fence at parking garage:
 - a. Panel size: 4 feet, 6 inches high by 6 feet long.
 - b. Panel Style: Three rail.
 - 4. Guardrail fence:
 - a. Panel size: 3 feet, 6 inches high by 6 feet long.
 - b. Panel Style: Three rail.
- C. Posts: Steel tube.
 - 1. Size: 2-1/2 inches square by 12 gauge, 0.109 inch, with manufacturer's standard cap.
 - 2. Post Cap: Flush plate.

- D. Rails: Manufacturer's standard, double-wall steel channel 1-3/4 inch square by 12 gauge, 0.1094 inch with prepunched picket holes.
 - 1. Picket Retaining Rods: 0.125 inch galvanized steel.
 - 2. Picket-to-Rail Intersection Seals: PVC grommets.
- E. Pickets: Steel tube.
 - 1. Spacing: 3-3/4 inch clear.
 - 2. Size: 1 inch square by 14 gauge, .064 inch.
 - 3. Style: Pickets with finial extend above top rail.
 - 4. Finial: Spear point.
- F. Flexibility: Capable of following variable slope of up to 1:2.
- G. Pedestrian Gates: Self-closing swing gate with integrated hinge-closer.
 - 1. Prepare gate to receive door hardware specified in Section 08 7100.

2.04 VEHICLE GATES

- A. Provide cantilever gate matching specifications for Welded Steel Fence.
 - 1. Basis of Design: Ameristar Transport II, Classic
 - 2. Substitutions: See Section 01 6000 Product Requirements.
- B. Suspension rollers for enclosed tracks:
 - 1. Locate at each support post to track connection.
 - 2. Provide truck assembly capable of being adjusted vertically via threaded rod for fine-tune adjustment.
 - 3. Top and bottom enclosued truck assemblies shall be mechanically fastened to vertical gate uprights and intermediate supports, as required by assembly instructions.
 - 4. Provide diagonal bracing as required by manufacturer to maintain smooth operation of gates.
- C. Clear Opening: As indicated on Drawings.
- D. Height: As indicated on Drawings.

2.05 AUTOMATIC GATE OPERATORS

- A. Sliding Gates: Prewired, pedestal-mounted gate operator for horizontal sliding gates, per ASTM F2200 and UL 325.
 - 1. Basis of Design: Nice | HySecurity: SlideDriver 50VF2/3
 - 2. Substitutions: See Section 01 6000 Product Requirements.
 - 3. Operating type: Hydraulic.
 - 4. Control Functions: Open, Pause, Close.
 - 5. Rate of Travel: Field adjustable, 2.2 foot/second to 3 foot/second
 - 6. Access: Card, Keypad, and Remote.
 - a. Provide connection for Emergency Services receiver to allow Emergency Services to remotely open gate.
 - 7. Maximum gate weight: 5,000 pounds.
 - 8. Horsepower Rating: Suitable for connected load.
 - 9. Entrapment Protection Devices: Provide sensing devices and safety mechanisms complying with UL 325.
 - a. Primary Device: Provide electric sensing edge, wireless sensing, NEMA 1 photo eye sensors, or NEMA 4X photo eye sensors as required with momentary-contact control device.
 - 10. Vehicle Loops: Locate as required for intended operation of gate.
 - 11. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - a. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - 1) Outdoor Locations: Type 3R.

b. Finish for Painted Steel Enclosures: Manufacturer's standard, zinc plated with powder coating.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Set fence posts in accordance with the manufacturer recommended spacing.
- C. Space gate posts according to the manufacturers' drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected.
 - 1. Base type and quantity of gate hinges on the application, weight, height, and number of gate cycles.
 - 2. Identify the necessary hardware required for the application on the manufacturer's gate drawings.
- D. Install operator in accordance with manufacturer's instructions and in accordance with NFPA 70.
- E. Coordinate controls of vehicle gate with the Work of other sections and Owner requirements.

3.02 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch.
- B. Maximum Offset From Indicated Position: 1 inch.
- C. Minimum Distance from Property Line: 6 inches.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 4000 Quality Requirements, for additional requirements.
- B. Layout: Verify that fence installation markings are accurate to design, paying attention to gate locations, underground utilities, and property lines.
- C. Post Settings: Randomly inspect three locations against design for:
 - 1. Hole diameter.
 - 2. Hole depth.
 - 3. Hole spacing.
- D. Gates: Inspect for level, plumb, and alignment.
- E. Workmanship: Verify neat installation free of defects.

3.04 CLEANING

- A. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.
- B. Clean fence with mild household detergent and clean water rinse well.
- C. Remove mortar from exposed posts and other fencing material using a 10 percent solution of muriatic acid followed immediately by several rinses with clean water.
- D. Touch up scratched surfaces using materials recommended by manufacturer. Match touched-up paint color to factory-applied finish.

3.05 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 Demonstration and Training, for additional requirements.
- C. Training: Train Owner's personnel on operation and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.
 - 3. Location: At project site.

3.06 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair, or replace damaged products before Date of Substantial Completion.

SECTION 33 01 10.58

DISINFECTION OF WATER UTILITY PIPING SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Disinfection of site domestic water lines and site fire water lines specified in Section 33 14 16.
- B. Testing and reporting results.

1.02 RELATED REQUIREMENTS

A. Section 33 14 16 - Site Water Utility Distribution Piping.

1.03 REFERENCE STANDARDS

- A. AWWA B300 Hypochlorites; 2011.
- B. AWWA B301 Liquid Chlorine; 2010.
- C. AWWA B302 Ammonium Sulfate; 2010.
- D. AWWA B303 Sodium Chlorite; 2010.
- E. AWWA C651 Disinfecting Water Mains; 2005.

1.04 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
- B. Test Reports: Indicate results comparative to specified requirements.
- C. Disinfection report:
 - 1. Type and form of disinfectant used.
 - 2. Date and time of disinfectant injection start and time of completion.
 - 3. Test locations.
 - 4. Initial and 24 hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
 - 5. Date and time of flushing start and completion.
 - 6. Disinfectant residual after flushing in ppm for each outlet tested.
- D. Bacteriological report:
 - 1. Date issued, project name, and testing laboratory name, address, and telephone number.
 - 2. Time and date of water sample collection.
 - 3. Name of person collecting samples.
 - 4. Test locations.
 - 5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
 - 6. Coliform bacteria test results for each outlet tested.
 - 7. Certification that water conforms, or fails to conform, to bacterial standards of Medford Water Commission.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with AWWA C651.

1.06 REGULATORY REQUIREMENTS

- A. Conform to applicable code or regulation for performing the work of this Section.
- B. Provide certificate of compliance from authority having jurisdiction indicating approval of water system.

PART 2 PRODUCTS

2.01 DISINFECTION CHEMICALS

A. Chemicals: AWWA B300, Hypochlorite, AWWA B301, Liquid Chlorine, AWWA B302, Ammonium Sulfate, and AWWA B303, Sodium Chlorite. Coordinate acceptable chemical with plumbing code and authority having jurisdiction.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that piping system has been cleaned, inspected, and pressure tested.
- B. Schedule disinfecting activity to coordinate with start-up, testing, adjusting and balancing, demonstration procedures, including related systems.

3.02 DISINFECTION

- A. Use method prescribed by the applicable state or local codes, or health authority or water purveyor having jurisdiction, or in the absence of any of these follow AWWA C651.
- B. Provide and attach equipment required to perform the work.
- C. Inject treatment disinfectant into piping system.
- D. Maintain disinfectant in system for 24 hours (verify with authority having jurisdiction).
- E. Flush, circulate, and clean until required cleanliness is achieved; use municipal domestic water.
- F. Replace permanent system devices removed for disinfection.
- G. Pressure test system to 150 psi. Repair leaks and re-test.

3.03 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01 40 00.
- B. Test samples in accordance with AWWA C651.

SECTION 33 05 13 MANHOLES AND STRUCTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Modular precast concrete manhole and vault sections with tongue-and-groove joints, covers, anchorage, and accessories.

1.02 REFERENCE STANDARDS

- A. ACI 530/530.1/ERTA Building Code Requirements and Specification for Masonry Structures and Related Commentaries; 2011.
- B. ASTM A48/A48M Standard Specification for Gray Iron Castings; 2003 (Reapproved 2012).
- C. ASTM C478 Standard Specification for Circular Precast Reinforced Concrete Manhole Sections; 2015.
- D. ASTM C923 Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals; 2008 (Reapproved 2013).
- E. IMIAWC (CW) Recommended Practices & Guide Specifications for Cold Weather Masonry Construction; International Masonry Industry All-Weather Council; 1993.

1.03 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate manhole and vault locations, elevations, piping sizes and elevations of penetrations.
- C. Product Data: Provide manhole and vault covers, component construction, features, configuration, and dimensions.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.05 FIELD CONDITIONS

A. Cold and Hot Weather Requirements: Comply with requirements of ACI 530/530.1/ERTA or applicable building code, whichever is more stringent.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Manhole Sections: Reinforced precast concrete in accordance with ASTM C478 (ASTM C478M), with resilient connectors complying with ASTM C923 (ASTM C923M).
- B. Concrete: As specified in Section 03 30 00.
- C. Mortar and Grout: As specified in Section 04 20 00, Type S.

2.02 COMPONENTS

A. Lid and Frame: ASTM A48/A48M, Class 30B Cast iron construction, machined flat bearing surface, removable lockable (where specified) lid, closed lid design; live load rating of 11,520 psf; lid molded with identifying name ;.

2.03 CONFIGURATION

- A. Shaft Construction: Concentric with concentric cone top section; lipped male/female dry joints; sleeved to receive pipe sections.
- B. Shape: Cylindrical.
- C. Clear Inside Dimensions: As indicated.
- D. Design Depth: As indicated.
- E. Pipe Entry: Provide openings as indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify items provided by other sections of Work are properly sized and located.
- B. Verify that built-in items are in proper location, and ready for roughing into Work.
- C. Verify excavation for manholes is correct.

3.02 MANHOLES

- A. Place manhole sections plumb and level, trim to correct elevations, anchor to base pad.
- B. Cut and fit for pipe.
- C. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour as required.
- D. Set cover frames and covers level without tipping, to correct elevations.
- E. Coordinate with other sections of work to provide correct size, shape, and location.

SECTION 33 14 16 SITE WATER UTILITY DISTRIBUTION PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Water pipe for site conveyance lines.
- B. Pipe valves.
- C. Fire hydrants.
- D. Pipe and fittings for site water lines including domestic water lines and fire water lines.
- E. Valves and Fire hydrants.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 Cast-in-Place Concrete: Concrete for thrust restraints.
- B. Section 31 23 16 Excavation: Excavating of trenches.
- C. Section 31 23 16.13 Trenching: Excavating, bedding, and backfilling.
- D. Section 31 23 23 Fill: Bedding and backfilling.
- E. Section 33 01 10.58 Disinfection of Water Utility Piping Systems: Disinfection of site service utility water piping.

1.03 REFERENCE STANDARDS

- A. ASTM B88 Standard Specification for Seamless Copper Water Tube; 2014.
- B. ASTM D1785 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2015.
- C. ASTM D2855 Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings; 1996 (Reapproved 2010).
- D. ASTM D3139 Standard Specification for Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals; 1998 (Reapproved 2011).
- E. AWWA C111/A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2012.
- F. AWWA C151/A21.51 Ductile-Iron Pipe, Centrifugally Cast; 2009.
- G. AWWA C502 Dry-Barrel Fire Hydrants; 2014.
- H. AWWA C508 Swing-Check Valves for Waterworks Service, 2 In. (50 mm) Through 24 In. (600 mm) NPS; 2011.
- I. AWWA C509 Resilient-Seated Gate Valves for Water Supply Service; 2009.
- J. AWWA C600 Installation of Ductile-Iron Water Mains and Their Appurtenances; 2010.
- K. AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution; 2007.
- L. UL 246 Hydrants for Fire-Protection Service; Current Edition, Including All Revisions.
- M. Medford Water Commission Standards for Water Facilities.

1.04 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, mechanical joint and fitting restraint devices, and accessories.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with Medford Water Commission requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store valves in shipping containers with labeling in place.

PART 2 PRODUCTS

2.01 WATER PIPE

- A. Ductile Iron Pipe: AWWA C151/A21.51:
 - 1. Fittings: Ductile iron, standard thickness.
- B. Copper Tubing: ASTM B88, Type K, Annealed:
- C. PVC Pipe: ASTM D1785, Schedule 40.
 - 1. Joints: ASTM D2855, solvent weld.
- D. PVC Pipe: AWWA C900 Class 150:
 - 1. Joints: ASTM D3139 compression gasket ring.
- E. Trace Wire: Magnetic detectable conductor, brightly colored blue plastic covering, imprinted with "Water Service " in large letters.

2.02 VALVES

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Gate Valves Up To 3 Inches:
 - 1. Brass or Bronze body, non-rising stem, inside screw, single wedge or disc, compression ends, with control rod, post indicator, valve key, and extension box.
- C. Gate Valves 3 Inches and Over:
 - 1. AWWA C509, iron body, bronze trim, non-rising stem with square nut, single wedge, resilient seat, flanged ends, control rod, post indicator, valve key, and extension box.
- D. Ball Valves Up To 2 Inches:
 - 1. Brass body, Teflon coated brass ball, rubber seats and stem seals, Tee stem pre-drilled for control rod, AWWA inlet end, compression outlet with electrical ground connector, with control rod, valve key, and extension box.
- E. Swing Check Valves From 2 Inches to 24 Inches:
 - 1. AWWA C508, iron body, bronze trim, 45 degree swing disc, renewable disc and seat, flanged ends.

2.03 HYDRANTS

- A. Hydrants: Type as required by Medford Water Commission.
- B. Hose and Streamer Connection: Match sizes with utility company, two hose nozzles, one pumper nozzle, pumper nozzle must face street.
- C. Finish: Primer and two coats of enamel in color required by utility company.

2.04 BEDDING AND COVER MATERIALS

- A. Bedding: As specified in Section 31 23 16.13.
- B. Cover: As specified in Section 31 23 16.13.

2.05 ACCESSORIES

- A. Concrete for Thrust Restraints: Concrete type specified in Section 03 30 00.
- B. Mechanical Joint & Fitting Restraint: All pipe and fittings shall be restrained as specified on plan set. Mechanical restraint shall be by Romac Industries, Inc., or EBAA Iron, Inc, or approved equal. Fitting and joint restraint systems shall be installed as specified by respective system manufacturer for the type of pipe being restrained. Contractor shall submit for approval the manufacturers installation specifications for product being used.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that building service connection and municipal utility water main size, location, and invert are as indicated.

3.02 PREPARATION

- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare pipe connections to equipment with flanges or unions.

3.03 TRENCHING

A. See Section 31 23 16.13 for additional requirements.

3.04 INSTALLATION - PIPE

- A. Maintain separation of water main from sewer piping in accordance with applicable code.
- B. Establish elevations of buried piping to ensure not less than 3 ft of cover from finished grade for fire line. Domestic water line elevation to be established below local frost line.
- C. Install ductile iron piping and fittings to AWWA C600.
- D. Route pipe in straight line.
- E. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- F. Install access fittings to permit disinfection of water system performed under Section 33 01 10.58.
- G. Install trace wire 6 inches above top of pipe; coordinate with Section 31 23 16.13.

3.05 INSTALLATION - VALVES AND HYDRANTS

- A. Set valves on solid bearing.
- B. Center and plumb valve box over valve. Set box cover flush with finished grade.
- C. Set hydrants plumb; locate pumper nozzle perpendicular to and facing roadway in accordance with Section 21 11 00.
- D. Set hydrants to grade, with nozzles at least 20 inches above ground in accordance with Section 21 11 00.

3.06 FIELD QUALITY CONTROL

- A. See Section 01 40 00 Quality Requirements, for additional requirements.
- B. Perform field inspection and testing in accordance with Section 01 40 00.
- C. Pressure test water piping to 150 pounds per square inch.
- D. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

SECTION 33 31 13 SITE SANITARY SEWERAGE GRAVITY PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sanitary sewerage drainage piping, fittings, and accessories.
- B. Connection of building sanitary drainage system to existing sewer stubs, mains, or manholes.
- C. Cleanout access.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 Cast-in-Place Concrete: Concrete for cleanout base pad construction.
- B. Section 31 23 16 Excavation: Excavating of trenches.
- C. Section 31 23 16.13 Trenching: Excavating, bedding, and backfilling.
- D. Section 31 23 23 Fill: Bedding and backfilling.
- E. Section 33 05 13 Manholes and Structures.

1.03 REFERENCE STANDARDS

- A. ASTM D1785 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2015.
- B. ASTM D2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2014.
- C. ASTM D2729 Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2011.
- D. ASTM D3034 Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2015.
- E. Rogue Valley Sewer Services Design Standards.

1.04 DEFINITIONS

A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

1.05 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
- B. Project Record Documents:
 - 1. Record location of pipe runs, connections, manholes, cleanouts, and invert elevations.
 - 2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.06 REGULATORY REQUIREMENTS

A. Conform to applicable code for materials and installation of the Work of this section.

1.07 PROJECT CONDITIONS

A. Coordinate the Work with termination of sanitary sewer connection outside building, connection to existing system, and trenching.

PART 2 PRODUCTS

2.01 SEWER PIPE MATERIALS

- A. Plastic Pipe: ASTM D3034, Type PSM, Poly(Vinyl Chloride) (PVC) material; inside nominal diameter of (per plan) inches, bell and spigot style solvent sealed joint end.
- B. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.

2.02 PIPE ACCESSORIES

A. Trace Wire: Magnetic detectable conductor, brightly colored green plastic covering, imprinted with "Sewer Service " in large letters.

2.03 BEDDING AND COVER MATERIALS

- A. Pipe Bedding Material: As specified in Section 31 23 16.13.
- B. Pipe Cover Material: As specified in Section 31 23 16.13.

PART 3 EXECUTION

3.01 GENERAL

A. Perform work in accordance with applicable code(s).

3.02 TRENCHING

- A. See Section 31 23 16.13 for additional requirements.
- B. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.03 INSTALLATION - PIPE

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.
- B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.
 1. Plastic Pipe: Also comply with ASTM D2321.
- C. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- D. Connect to building sanitary sewer outlet .
- E. Install trace wire 6 inches above top of pipe; coordinate with Section 31 23 16.13.

3.04 INSTALLATION - CLEANOUTS

- A. Form bottom of excavation clean and smooth to correct elevation.
- B. Form and place cast-in-place concrete base pad, with provision for sanitary sewer pipe end sections.
- C. Establish elevations and pipe inverts for inlets and outlets as indicated.
- D. Mount lid and frame level in grout, secured to top cone section to elevation indicated.

3.05 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01 40 00.
- B. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
- C. Pressure Test: Test in accordance with current Oregon Plumbing Specialty Code standards/requirements.
- D. Deflection Test: Test in accordance with current Oregon Plumbing Specialty Code standards/requirements.

3.06 PROTECTION

A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

SECTION 33 41 00 SUBDRAINAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Building Perimeter and Retaining Wall Drainage Systems.
- B. Filter aggregate and fabric and bedding.

1.02 RELATED REQUIREMENTS

- A. Section 31 23 16 Excavation: Excavating for subdrainage system piping and surrounding filter aggregate.
- B. Section 31 23 16.13 Trenching: Excavating and backfilling for site subdrainage systems.
- C. Section 31 23 23 Fill: Backfilling over filter aggregate, up to subgrade elevation.

1.03 REFERENCE STANDARDS

A. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2011.

1.04 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Project Record Documents: Record location of pipe runs, connections, cleanouts and principal invert elevations.

1.05 REGULATORY REQUIREMENTS

A. Conform to applicable code for materials and installation of the work of this section.

PART 2 PRODUCTS

2.01 PIPE MATERIALS

- A. Polyvinyl Chloride Pipe: ASTM D 2729; plain end, 4 and 6 inch inside diameter (see plan); with required fittings.
- B. Corrugated Plastic Tubing: Flexible type; 4 and 6 inch diameter, with required fittings.
- C. Use perforated pipe at subdrainage system; unperforated through sleeved walls.

2.02 AGGREGATE AND BEDDING

A. Filter Aggregate and Bedding Material: Granular fill as specified in Section 31 23 23.

2.03 ACCESSORIES

- A. Pipe Couplings: Solid plastic.
- B. Filter Fabric: Water pervious type, black polyolefin. Refer to Section 31 23 23: Geotextile Fabric Filter

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.

3.02 PREPARATION

- A. Hand trim excavations to required elevations. Correct over-excavation with approved 3/4" minus ODOT spec.
- B. Remove large stones or other hard matter that could damage drainage piping or impede consistent backfilling or compaction.

3.03 INSTALLATION

- A. Install and join pipe and pipe fittings in accordance with pipe manufacturer's instructions.
- B. Place drainage pipe on compacted impervious fill.
- C. Lay pipe to slope gradients noted on drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- D. Place pipe with perforations facing down. Mechanically join pipe ends.
- E. Install filter aggregate at sides, over joint covers and top of pipe. Provide top cover compacted thickness of 12 inches.
- F. Place filter fabric around and over levelled top surface of Drainage Fill aggregate cover prior to subsequent backfilling operations.
- G. Refer to Section 31 23 23 for compaction requirements. Do not displace or damage pipe when compacting.
- H. Connect to storm sewer system with unperforated pipe at locations indicated on plan. Provide approved backflow check valves as specified on plan.

3.04 FIELD QUALITY CONTROL

- A. Section 01 40 00 Quality Requirements: Field inspection and testing.
- B. Request inspection prior to and immediately after placing aggregate cover over pipe.

3.05 PROTECTION

A. Protect pipe and aggregate cover from damage or displacement until backfilling operation begins.

END OF SECTION

SECTION 33 42 11 SITE STORM UTILITY DRAINAGE PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Stormwater drainage piping.
- B. Stormwater pipe accessories.
- C. Connection of drainage system to existing drainage systems (public and private).
- D. Catch basins, Plant area drains, Paved area drainage, and Site surface drainage.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 Cast-in-Place Concrete: Concrete for cleanout base pad construction.
- B. Section 31 23 16 Excavation: Excavating of trenches.
- C. Section 31 23 16.13 Trenching: Excavating, bedding, and backfilling.
- D. Section 31 23 23 Fill: Bedding and backfilling.
- E. Section 33 05 13 Manholes and Structures.

1.03 REFERENCE STANDARDS

- A. AASHTO M 252 Standard Specification for Corrugated Polyethylene Drainage Pipe; 2009.
- B. ASTM A48/A48M Standard Specification for Gray Iron Castings; 2003 (Reapproved 2012).
- C. ASTM C14 Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe; 2015.
- D. ASTM C14M Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe (Metric); 2015.
- E. ASTM C76 Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe; 2015.
- F. ASTM C443 Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets; 2012.
- G. ASTM C443M Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric); 2011.
- H. ASTM D1785 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2015.
- I. ASTM D2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2014.
- J. ASTM D2680 Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping; 2001 (Reapproved 2014).
- K. ASTM D2729 Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2011.
- L. ASTM D3034 Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2015.
- M. ASTM D3350 Standard Specification for Polyethylene Plastics Pipe and Fittings Material; 2012.
- N. ASTM F 405 Standard Specification for Corregated Polyethylene Drainage Pipe and Fittings in Nominal sizes 3 inches to 6 inches in diameter.
- O. ASTM F 477 Standard Specification for Elastomeric Seals (gaskets) for Joining Pipe
- P. ASTM F 667 Standard Specification for Large Diameter Corregated Polyethylene Drainage Pipe and Fittings in Nominal sizes 8 inches to 24 inches in diameter.

1.04 DEFINITIONS

A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

- B. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.
- C. Project Record Documents:
 - 1. Record location of pipe runs, connections, and invert elevations.
 - 2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.06 REGULATORY REQUIREMENTS

A. Conform to applicable code for materials and installation of the Work of this section.

1.07 PROJECT CONDITIONS

A. Coordinate the Work with termination of storm sewer connection outside building, trenching, connection to foundation drainage system and municipal sewer utility service.

PART 2 PRODUCTS

2.01 STORMWATER PIPE MATERIALS

- A. Corrugated HDPE Pipe and Fittings: ASTM F 2306.
- B. Corrugated HDPE Pipe and Fittings: ASTM F 2648.
- C. Concrete Pipe: Nonreinforced, ASTM C14 (ASTM C14M), Class 1; inside nominal diameter of per plan inches, bell and spigot end joints.
- D. Concrete Pipe Joint Devices: ASTM C443 (ASTM C443M) rubber compression gasket joint.
- E. Reinforced Concrete Pipe Joint Device: ASTM C443 (ASTM C443M) rubber compression gasket joint.
- F. Plastic Pipe: ASTM D3034, Type PSM, Poly Vinyl Chloride (PVC) material; inside nominal diameter of per plan inches, bell and spigot style solvent sealed joint end.
- G. Corrugated Steel Pipe: AASHTO M 36 Type I; nominal diameter of per plan inches, _____ end joints; helical lock seam; coated inside and out with 0.050 inch thick bituminous coating.
- H. Coupling Bands: Galvanized steel, 0.052 inches thick x 10 inches (250 mm) wide; connected with two neoprene "O" ring gaskets and two galvanized steel bolts.
- I. Polyethlyne Pipe: Corrugated HDPE pipe and fittings, Hancor Sur-Lok or ADS N-12 (all pipe joints to be water tight).

2.02 PIPE ACCESSORIES

- A. Elastormeric Seals (Gaskets): ASTM F 477.
- B. Trace Wire: Magnetic detectable conductor, brightly colored green plastic covering, imprinted with "Storm Sewer Service " in large letters.
- C. Downspout Boots: Smooth interior without boxed corners or choke points; include integral lug slots and on-body cleanout and cover with neoprene gaskets.
 - 1. Configuration: Angular.
 - 2. Material: Cast iron; ASTM A48/A48M; casting thickness 3/8 inch (9.5 mm), minimum.
 - 3. Accessories: Manufacturer's standard stainless steel fasteners, stainless steel building wall anchors, and rubber coupling.

2.03 CATCH BASIN, TRENCH DRAINS, CLEANOUT, AND AREA DRAIN COMPONENTS

- A. Lids and Drain Covers:
 - 1. Catch Basin: Per plan
 - 2. Cleanout: Per plan
 - 3. Area Drain: Per plan

2.04 BEDDING AND COVER MATERIALS

- A. Bedding: As specified in Section 31 23 16.13.
- B. Cover: As specified in Section 31 23 16.13.

PART 3 EXECUTION

3.01 TRENCHING

- A. See Section 31 23 16.13 Trenching for additional requirements.
- B. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.02 INSTALLATION

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.
- B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.
 - 1. Plastic Pipe: Also comply with ASTM D2321.
- C. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- D. Connect to building storm drainage system, foundation drainage system, and utility/municipal system.
- E. Connect to building collection pits .
- F. Install continuous trace wire 6 inches above top of pipe; coordinate with Section 31 23 16.13.

3.03 INSTALLATION - CATCH BASINS AND CLEANOUTS

- A. Form bottom of excavation clean and smooth to correct elevation.
- B. Form and place cast-in-place concrete base pad, with provision for sanitary sewer pipe end sections (where applicable).
- C. Establish elevations and pipe inverts for inlets and outlets as indicated.
- D. Mount lid and frame level in grout, secured to top cone section to elevation indicated.

3.04 FIELD QUALITY CONTROL

- A. Perform field inspection in accordance with Section 01 40 00 Quality Requirements.
- B. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
- C. Pressure Test: Test in accordance with Oregon Plumbing Specialty Code standards/requirements.
- D. Deflection Test: Test in accordance with Oregon Plumbing Specialty Code standards/requirements.

3.05 PROTECTION

A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

Appendix A

Referenced AIA Documents

DRAFT AIA Document A101[™] - 2017

Standard Form of Agreement Between Owner and Contractor

where the basis of payment is a Stipulated Sum

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)*

 « Rogue Valley Transportation District»« »
 « » FILL IN DEPARTMENT NAME AND ADDRESS HERE Medford, Oregon

« » « A101-2017-Modified version 2018-12-21 »

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

« FILL IN THE CONTRACTOR'S INFORMATION HERE »« »
« »
« »
« »

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

« FILL IN THE PROJECT NAME HERE » «» «»

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

« FILL IN ARCHITECT'S NAME HERE » «ARCHITECT'S ADDRESS HERE Eugene, OR 97401» «Telephone Number: » « »

The Owner and Contractor agree as follows.

ADDITIONS AND DELETIONS:

The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An Additions and Deletions Report that notes added information as well as 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 or modification.

The parties should complete Al01[™]-2017, Exhibit A, Insurance and Bonds, contemporaneously with this Agreement. AIA Document A201[™]-2017, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.



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- 2 THE WORK OF THIS CONTRACT
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- CONTRACT SUM 4
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EXHIBIT A INSURANCE AND BONDS

THE CONTRACT DOCUMENTS **ARTICLE 1**



The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement, and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9.

ARTICLE 2 THE WORK OF THIS CONTRACT

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

DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION ARTICLE 3

§ 3.1 The date of commencement of the Work shall be: (Check one of the following boxes.)

- [« »] The date of this Agreement.
- [« »] A date set forth in a notice to proceed issued by the Owner.
- [« »] Established as follows: (Insert a date or a means to determine the date of commencement of the Work.)

« »

If a date of commencement of the Work is not selected, then the date of commencement shall be the date of this Agreement.

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

§ 3.3 Substantial Completion

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

(Check one of the following boxes and complete the necessary information.)

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- [« »] Not later than « » (« ») calendar days from the date of commencement of the Work.
- [**« »**] By the following date: « »

§ 3.3.2 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:

Portion of Work	Substantial Completion Date	

§ 3.3.3 If the Contractor fails to achieve Substantial Completion as provided in this Section 3.3, liquidated damages, if any, shall be assessed as set forth in Section 4.5.

ARTICLE 4 CONTRACT SUM

§ 4.1 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 «Zero Dollars and Zero Cents» (\$ «0.00»), subject to additions and deductions as provided in the Contract Documents.

§ 4.2 Alternates

§ 4.2.1 Alternates, if any, included in the Contract Sum:

Item	Price	

3

§ 4.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement. (*Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.*)

	Item	Price	Conditions for Acceptance	
§ 4.3 Allo (Identify e	owances, if any, included in the Contract Sum each allowance.)	1:		
	Item	Price		
§ 4.4 Uni (Identify 1	§ 4.4 Unit prices, if any: (Identify the item and state the unit price and quantity limitations, if any, to which the unit price will be applicable.)			
	Item	Units and Limitations	Price per Unit (\$0.00)	
§ 4.5 Liq <i>(Insert ter</i>	uidated damages, if any: rms and conditions for liquidated damages, if	fany.)		
« No liqu General C portion of	idated damages are provided for in the Contra Conditions, Owner does not waive any claim f f the work in the established Contract Time.	act Documents; however, pursua for damages due to Contractor's »	ant to Section 15.1.7 of the failure to complete any	
§ 4.6 Oth (Insert pr	er: ovisions for bonus or other incentives, if any,	that might result in a change to	the Contract Sum.)	
« »				

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ARTICLE 5 PAYMENTS

§ 5.1 Progress Payments

§ 5.1.1 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.

§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

« »

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the «25th » day of a month, the Owner shall make payment of the amount certified to the Contractor not later than the «10th » day of the «following » month. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner not later than «fifteen » («15 ») days after the Architect receives the Application for Payment.

(Federal, state or local laws may require payment within a certain period of time.)

§ 5.1.4 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form, and supported by such data to substantiate its accuracy, as the Architect may require. This schedule of values shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 5.1.5 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

§ 5.1.6 In accordance with AIA Document A201TM–2017, General Conditions of the Contract for Construction, and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

§ 5.1.6.1 The amount of each progress payment shall first include:

- .1 That portion of the Contract Sum properly allocable to completed Work;
- .2 That portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction, or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing; and
- .3 That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified.

§ 5.1.6.2 The amount of each progress payment shall then be reduced by:

- .1 The aggregate of any amounts previously paid by the Owner;
- .2 The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A201–2017;
- .3 Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;
- .4 For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A201–2017; and
- .5 Retainage withheld pursuant to Section 5.1.7.

§ 5.1.7 Retainage

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

(Insert a percentage or amount to be withheld as retainage from each Application for Payment. The amount of retainage may be limited by governing law.)

«Withholding and payment of retainage shall be in accordance with ORS 701.410 et seq »

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§ 5.1.7.1.1 The following items are not subject to retainage:

(Insert any items not subject to the withholding of retainage, such as general conditions, insurance, etc.)

« »

§ 5.1.7.2 Reduction or limitation of retainage, if any, shall be as follows:

(If the retainage established in Section 5.1.7.1 is to be modified prior to Substantial Completion of the entire Work, including modifications for Substantial Completion of portions of the Work as provided in Section 3.3.2, insert provisions for such modifications.)

«As provided in ORS 701.435 »

§ 5.1.7.3 Except as set forth in this Section 5.1.7.3, upon Substantial Completion of the Work, the Contractor may submit an Application for Payment that includes the retainage withheld from prior Applications for Payment pursuant to this Section 5.1.7. The Application for Payment submitted at Substantial Completion shall not include retainage as follows:

(Insert any other conditions for release of retainage upon Substantial Completion.)

« »

§ 5.1.8 If final completion of the Work is materially delayed through no fault of the Contractor, the Owner shall pay the Contractor any additional amounts in accordance with Article 9 of AIA Document A201–2017.

§ 5.1.9 Except with the Owner's prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

§ 5.2 Final Payment

§ 5.2.1 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 Article 12 of AIA Document A201–2017, and to satisfy other requirements, if any, which extend beyond final payment; and
- .2 a final Certificate for Payment has been issued by the Architect.

§ 5.2.2 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:

« »

§ 5.3 Interest

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.)

« »% « As provided in ORS 701.420 »

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Initial Decision Maker

The Architect will serve as the Initial Decision Maker pursuant to Article 15 of AIA Document A201–2017, unless the parties appoint below another individual, not a party to this Agreement, to serve as the Initial Decision Maker. (If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

- « »
- « »

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« »
« »
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§ 6.2 Binding Dispute Resolution

For any Claim subject to, but not resolved by, mediation pursuant to Article 15 of AIA Document A201–2017, the method of binding dispute resolution shall be as follows: *(Check the appropriate box.)*

[* >] Arbitration pursuant to Section 15.4 of AIA Document A201–2017
 [* >] Litigation in a court of competent jurisdiction
 [* >] Other (Specify)

 (* >
 (> >)

 Owner and Contractor do not select a method of binding dispute resolution, or do not subsequent

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 by litigation in a court of competent jurisdiction.

ARTICLE 7 TERMINATION OR SUSPENSION

§ 7.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2017.

§ 7.1.1 If the Contract is terminated for the Owner's convenience in accordance with Article 14 of AIA Document A201–2017, then the Owner shall pay the Contractor a termination fee as follows: (Insert the amount of, or method for determining, the fee, if any, payable to the Contractor following a termination for the Owner's convenience.)

« »

§ 7.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201–2017.

ARTICLE 8 MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A201–2017 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

§ 8.2 The Owner's representative:

(Name, address, email address, and other information)

« »

« »

« »

« » « »

« » « »

§ 8.3 The Contractor's representative: (*Name, address, email address, and other information*)

« »

« »

« »

« »

« » « »

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

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§ 8.5 Insurance and Bonds

§ 8.5.1 The Owner and the Contractor shall purchase and maintain insurance as set forth in in the Contract Documents.

§ 8.5.2 The Contractor shall provide bonds as set forth in in the Contract Documents.

§ 8.6 [Section	n Deleted]		Π	
« »				
§ 8.7 Other pr	ovisions:			
« »				
ARTICLE 9 § 9.1 This Agr .1	ENUMERATION OF CONTRACT DOCU reement is comprised of the following d AIA Document A101 TM –2017, Standar	MENTS ocuments: rd Form of Agreement Betwe	en Owner and Contractor	
.2	AIA Document A201 ^{1M} –2017, Genera	I Conditions of the Contract f	for Construction	
	« »			
.3	Drawings			
	Number	Title	Date	
.4	Specifications			
	Section	Title	Date Pages	
.5	Addenda, if any:		\sim	
	Number	Date	Pages	
	Portions of Addenda relating to bidding or proposal requirements are not part of the Contract Documents unless the bidding or proposal requirements are also enumerated in this Article 9.			
.6	Other Exhibits: (Check all boxes that apply and include appropriate information identifying the exhibit where required.)			
	[« »]		\frown	
	« »			
	[« »] The Sustainability Plan:			
	Title	Date	Pages	
	[« »] Supplementary and other Con	ditions of the Contract:		

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	Document	Title	Date	Pages
.7	Other documents, if any, lista (List here any additional doc Document A201 [™] –2017 pro sample forms, the Contractor requirements, and other info proposals, are not part of the documents should be listed h	ed below: suments that are intended to for vides that the advertisement or r's bid or proposal, portions of rmation furnished by the Owner e Contract Documents unless er ere only if intended to be part of	m part of the Contract I invitation to bid, Instru Addenda relating to bia r in anticipation of rece numerated in this Agree of the Contract Docume	Documents. AIA ctions to Bidders, lding or proposal iving bids or nent. Any such nts.)
This Agreen	nent entered into as of the day a	nd year first written above.		
OWNER (Signature)	CONTRACT	OR (Signature)	
(Printed n	name and title)	(Printed na	me and title)	

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RAFT AIA Document A201[™] - 2017

General Conditions of the Contract for Construction

for the following PROJECT:

(Name and location or address)

«BLANK DOCUMENTS» $\langle \rangle \rangle$

THE OWNER: (Name, legal status and address)

« »« »

« »

THE ARCHITECT:

(Name, legal status and address)

«PIVOT Architecture»«, Professional Corporation» «44 West Broadway. Suite 300 Eugene, OR 97401»

Modified PIVOT Public Projects Master Version dated 2017-11-1206

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author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An Additions and Deletions Report that notes added information as well as 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 or modification.

For guidance in modifying this document to include supplementary conditions, see AIA Document A503™, Guide for Supplementary Conditions.





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- 14 TERMINATION OR SUSPENSION OF THE CONTRACT
- 15 CLAIMS AND DISPUTES





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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement, and Modifications issued after execution of the Contract. 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. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding or proposal requirements.

§ 1.1.2 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 (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect or the Architect's consultants, or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

§ 1.1.3 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.

§ 1.1.4 The Project

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by Separate Contractors.

§ 1.1.5 The Drawings

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

§ 1.1.6 The Specifications

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

.1 Numbering or lettering of Divisions, Sections, and paragraphs in the Specifications are merely for identification and may not be consecutive.

.2 The Specifications are of abbreviated or streamline type, and frequently include incomplete sentences. Words such as "shall," "must," "Contractor shall" and similar mandatory phrases must be supplied by inference in the same manner as in a note on the drawings. Omission of a mandatory phrase will not relieve Contractor of the obligation to provide all products listed and perform all operations necessary to complete the Work.

.3 Unless otherwise stated, any reference to codes, standard specifications, or other standards means the latest edition of such documents adopted as of the bid date. Where brand name products are specified and installation instructions are not included in the Contract Documents, the Contractor must install the product in accordance with each manufacturer's current specifications and written instructions.

.4 No provision in any reference standard, standard specification, manual or code will be effective to change the privileges or obligations of the Owner, the Architect, or the Contractor, or any of their respective consultants, agents or employees, from those set forth in the Contract Documents.

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.5 The Sections of Division 1, General Requirements govern the execution of all sections of the Specifications.

§ 1.1.7 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.

§ 1.1.8 Initial Decision Maker

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2. The Initial Decision Maker shall not show partiality to the Owner or Contractor and shall not be liable for results of interpretations or decisions rendered in good faith.

.1 Unless the Owner and Contractor mutually agree otherwise, the Architect is the person identified as the Initial Decision Maker.

§ 1.1.9. Additional Definitions

.1 "Approved" means "approved by the Architect."

.2 "As directed" means "as directed by the Architect."

.3 "As shown" means "as indicated," "as detailed," "as noted," or words of similar construction.

.4 "For approval" means "for the Architect's approval."

.5 "Or approved" means "or an equivalent product that has been approved in writing by the Architect."

.6 "N.I.C." or "NIC" means "not in Contract," and indicates a product that will be furnished and installed by

the Owner, the accommodation of which must be provided for by the Contractor.

.7 "OF/CI" or means "Owner-furnished and Contractor-installed," and indicates a product that will be furnished by the Owner, but receipt, accommodation, and installation of which must be provided for by the Contractor.

.8 "OF/OI" or means "Owner-furnished and Owner-installed," and indicates a product that will be furnished and installed by the Owner, the accommodation of which must be provided for by the Contractor.

.9 "Product" includes materials, systems, and equipment.

.10 "Project Manual" means the volume which includes the Bidding Requirements, Conditions of the Contract, and Specifications.

.11 "Provide" means "furnish and install" or "furnish labor and materials required for installation," ready for use and in accordance with the Contract Documents.

.12 "Selected" means "selected by the Architect."

§ 1.2 Correlation and Intent of the Contract Documents

§ 1.2.1 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 only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

§ 1.2.1.1 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.

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.2.4 If work is required in such a manner as to make it impossible to produce first-class work, or should discrepancies appear among Contract Documents, or if the Contractor is in doubt as to the meaning of Contract provisions, the Contractor must request interpretation from the Architect before proceeding with such work. If the

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§ 1.3 Capitalization

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles, or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 Interpretation

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.4.1 Wherever, in the Contract Documents, a product is referred to in singular number, such reference shall include as many such product as are shown on drawings or required to complete the work.

§ 1.5 Ownership and Use of Drawings, Specifications, and Other Instruments of Service

§ 1.5.1 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 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 \$ervice. 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.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors, and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, 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 the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

§ 1.6 Notice

§ 1.6.1 Except as otherwise provided in Section 1.6.2, 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 if a method for electronic transmission is set forth in the Agreement.

§ 1.6.2 Notice of Claims as provided in Section 15.1.3 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.

§ 1.7 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. The parties will use the information provided in Section 1.7 unless the parties agree to use AIA Document E203TM-2013, Building Information Modeling and Digital Data Exhibit, to establish the protocols for the development, use, transmission, and exchange of digital data.

1.7.1 Contractor's Use of Instruments of Service in Digital Form

.1 The Architect may, with the concurrence of the Owner, furnish to the Contractor versions of Instruments of Service in digital form. The Contract Documents executed or identified in accordance with Subparagraph 1.1.1 shall prevail in case of an inconsistency with subsequent versions made through manipulatable digital means involving computers.

.2 The Contractor shall not transfer or reuse Instruments of Service in digital or machine-readable form without the prior written consent of the Architect.

.3 The data contained in these digital files are part of the Instruments of Service and shall not be used by the contractor, or anyone else receiving these digital files through or from them, for any purpose other than as a convenience for work under this project. Any other use or reuse by the Contractor or by others will be at their sole risk and without liability or legal exposure to the Owner, Architect or the Architect's Consultants. The Contractor agrees to make no claim and hereby waives, to the fullest extent permitted by law, any claim or cause of action of any nature against the Owner and the Architect, or their officers, directors, employees, agents or Consultants that may arise out of or in connection with the Contractor's use of these digital files in any way. The Contractor must still obtain a full set of bid documents from the Owner's official web site, or other designated source, in digital form, and in submitting their bid and executing the work of this contract, should rely on the full set downloaded in digital form rather than any documents obtained from any other sources.

.4 Furthermore, the contractor shall, to the fullest extent permitted by law, indemnify and hold the Owner, Architect and their officers, agents, employees, and consultants harmless against all damages, liabilities or costs, including reasonable attorney's fees and defense costs, arising out of or resulting from the Contractor's use of these digital files.

5 Any passwords provided by Architect to obtain temporary access to the Architect's centralized electronic document management system are subject to the Architect's security requirements and use limitations, and use is limited to this Project.

.6 The Owner does not make any representation as to the compatibility of these files with the Contractor's computer hardware or computer software, their methods of digital document organization, or their methods of printing digital documents. The Architect, their Consultants, and the Owner will not be responsible for any costs or charges associated with printing, transferring or converting these files for the Contractor's use.

.7 Other than the PDF versions of the signed and sealed Bid Documents available on the Owner's official web site, or other designated source, these digital files are not construction documents nor are they as-built drawings. Differences may exist between these digital files and corresponding signed and sealed construction documents obtained from the Owner's official web site or other designated source. The Owner makes no representation regarding the accuracy or completeness of the digital files the Contractor may receive directly from the Architect. In the event that a conflict arises between the signed or sealed digital files, the signed or sealed construction documents obtained from the Owner's official web site, or other designated source, shall govern. The Contractor is responsible for determining if any conflict exists. By their use of these digital files, the Contractor or anyone they are authorized to share these files with, are not relieved of their duty to fully comply with the contract documents, including, and without limitation, the need to check, confirm and coordinate all dimensions and details, take field measurements, verify field conditions and coordinate their work with that of other contractors for the project.

.8 Under no circumstances shall delivery of the digital files for use by the Contractor be deemed a sale by the Architect, their Consultants, or the Owner. The Owner makes no warranties, either express or implied, of merchantability and fitness for any particular purpose. In no event shall the Owner be liable for any loss of profit or any consequential damages as a result of the use or reuse of these digital files.

.9 By requesting and making use of any digital data files for this project the Contractor agrees to be bound by these terms of use.

§ 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set forth in <u>Section 1.7, or if provided</u> AIA Document E203TM–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document G202TM–2013, Project Building Information Modeling Protocol Form, shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

ARTICLE 2 OWNER

§ 2.1 General

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as

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§ 2.1.2 The Owner shall furnish to the Contractor, within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of, or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.

§ 2.2 Evidence of the Owner's Financial Arrangements

§ 2.2.1 Prior to commencement of the Work and upon 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 2.2.1, the Contract Time shall be extended appropriately.

§ 2.2.2 Following commencement of the Work and upon 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 only if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due; or (3) a change in the Work materially changes the Contract Sum. If the Owner fails to provide such evidence, as required, within fourteen days of the Contractor's request, the Contractor may immediately stop the Work and, in that event, shall notify the Owner that the Work has stopped. However, if the request is made because a change in the Work materially changes the Contractor may immediately stop only that portion of the Work affected by the change until reasonable evidence is provided. If the Work is stopped under this Section 2.2.2, the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided in the Contract Documents.

§ 2.2.3 After the Owner furnishes evidence of financial arrangements under this Section 2.2, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.4 Where the Owner has designated information furnished under this Section 2.2 as "confidential," the Contractor shall keep the information confidential and shall not disclose it to any other person. However, the Contractor may disclose "confidential" information, after seven (7) days' notice to the Owner, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by court or arbitrator(s) order. The Contractor may also disclose "confidential" information to its employees, consultants, sureties, Subcontractors and their employees, Sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.

§ 2.3 Information and Services Required of the Owner

§ 2.3.1 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

.1 The Building Permit and any applicable Systems Development Charges required by the Jurisdiction Having Authority of the project will be secured and paid for by the Owner.

§ 2.3.2 The Owner shall retain an architect lawfully licensed to practice architecture, or an entity lawfully practicing architecture, in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 2.3.3 If the employment of the Architect terminates, the Owner shall employ a successor to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.

§ 2.3.4 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. 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.

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§ 2.3.6 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one digital copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

.1 The Contractor must pay the cost of printing, reproduction, postage, and handling for any additional copies required by the Contractor in whatever form, including those required to be used for recording Record Drawing information.

§ 2.3.7 The Owner will procure and bear costs of structural tests and special inspections as required by the applicable building code. The Contractor will facilitate and schedule such tests and inspections required for building code compliance.

§ 2.4 Owner's Right to Stop the Work

If the Contractor fails to correct unsafe conditions, carry out reasonable directions, correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out 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 has been eliminated; however, the right of the Owner to stop the Work shall-may 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, except to the extent required by Section 6.1.3.

§ 2.5 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 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 9.5.1, 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 Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. 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 15.

ARTICLE 3 CONTRACTOR

§ 3.1 General

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.3 The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor,

§ 3.1.4 Compliance with Public Contracting Rules and Laws

.1 The Contractor must at all times comply with all requirements of Chapter 21 of the Lane Manual, Sections 21.130 and 21.131.

.2 The Contractor must ensure that workers in each trade or occupation that the Contractor or a Subcontractor or other person uses in performing some or all of the work are paid not less than the applicable federal or state prevailing rate of wage, in accordance with ORS 279C.838 and 279C.840. The Contractor must include this condition in every Subcontract arising out of this Contract.

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.3 The Contractor must keep the prevailing rates of wage for that project posted in a conspicuous and accessible place in or about the project; and if the Contractor or a Subcontractor provides or contributes to a health and welfare plan or a pension plan, or both, for the Contractor or Subcontractor's employees on the project, post a notice in a conspicuous and accessible place in or about the project describing the plan and containing information on how and where to make claims and where to obtain further information.

<u>.4</u> Before starting work on the Project, the Contractor and every Subcontractor must have a public works bond filed with the Construction Contractors Board, unless exempt under ORS 279C.836(4), (7), (8), or (9). The Contractor must include this condition in every Subcontract arising out of this Contract.

.5 Before starting work on the Project, the Contractor must demonstrate that Contractor has an employee drug testing program in place.

.6 The Contractor and all Subcontractors shall not discriminate against any employee or applicant for employment because of race, color, disability, religion, sex, age, national origin, political affiliation or beliefs, or marital status. The Contractor shall take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, disability, religion, sex, age, national origin, political affiliation or beliefs, or marital status. Such action shall include, but not be limited to: employment, upgrading, demotion or transfer, recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship.

.7 The Contractor shall post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this nondiscrimination clause.

.8 The Contractor's and all Subcontractor's solicitations and advertisements for employees shall state that all qualified applicants will receive consideration for employment without regard to race, color, disability, religion, sex, age, national origin, political affiliation or beliefs, or marital status.

.9 The Contractor must include these condition in every Subcontract arising out of this Contract.

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with and has made a careful examination of the location and local conditions under which the Work is to be performed, and the sources of supply for materials, and has made a careful examination of the Contract Documents; and has become fully informed as to the quality and quantity of materials and the character of the Work required, and has correlated personal observations with requirements of the Contract Documents. The Owner will not be responsible for any loss or for any unanticipated costs that may be suffered by the Contractor as a result of the Contractor's failure to acquire full information in advance in regard to all conditions pertaining to the Work which the Contractor knew or should have known through reasonable diligence. No oral statements by any officer, agent, consultant or personnel of the Owner, either before or after the execution of this Contract shall affect or modify any of the terms or obligations contained in the Contract.

§ 3.2.2 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 2.3.4, 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 Contract Documents.

§ 3.2.3 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.

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§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner, subject to Section 15.1.7, as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.3 Supervision and Construction Procedures

§ 3.3.1 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. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be solely responsible for the jobsite safety of such means, methods, techniques, sequences or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner and Architect, and shall propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. Unless the Architect objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative means, methods, techniques, sequences.

§ 3.3.2 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.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.4 Labor and Materials

§ 3.4.1 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.

§ 3.4.2 Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive. Any request for substitution of products in place of those specified must be made in accordance with the conditions set forth in the General Requirements (Division 1) of the Specifications.

§ 3.4.3 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 properly skilled in tasks assigned to them.

§ 3.5 Warranty

§ 3.5.1 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 and normal usage. If required by the Architect,

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§ 3.5.1 Neither the final certificate of payment nor any provision of the Contract Documents shall relieve the Contractor from responsibility for defective Work and, unless a longer period is specified, Contractor shall correct all defects that appear in the Work within a period of one year from the date of issuance of the written notice of Substantial Completion by the Owner, except for latent defects which will be remedied by the Contractor any time they become apparent subject to 13.7.

§ 3.5.2 Nothing in this section 3.5 negates guarantees or warranties for periods longer than one year, including without limitation such guarantees or warranties required by other sections of the Contract Documents for specific installations, materials, processes, equipment or fixtures. In addition to Contractor's warranty, manufacturers' warranties shall pass to the Owner and shall not take effect until affected Work has been accepted in writing by the Architect.

§ 3.5.2 All material, equipment, or other special 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 9.8.4.

§ 3.6 Taxes

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

§ 3.7 Permits, Fees, Notices and Compliance with Laws

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as forall other legally required permits, fees, licenses, and inspections by government agencies specified in the Contract Documents or 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 negotiation concluded.

.1 The Owner will pay for the Building Permit and any Systems Development Charges as stated in section 2.3.1.1 above.

§ 3.7.2 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.

§ 3.7.3 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.

§ 3.7.4 Concealed or Unknown Conditions

If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may submit a Claim as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately

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§ 3.7.6 The Contractor must comply with all federal, state and local laws, regulations, executive orders and ordinances applicable to the work under this agreement, including without limitations:

.1 Titles VI and VII of the Civil Rights Act of 1964, as amended,

.2 Title V and Sections 503 and 504 of the Rehabilitation Act of 1973, as amended,

.3 The Americans with Disabilities Act of 1990, as amended and ORS 659.425,

.4 The Health Insurance Portability and Accountability Act of 1996,

.5 The Age Discrimination in Employment Act of 1967, as amended, and the Age Discrimination Act of 1975, as amended,

.6 The Vietnam Era Veterans' Readjustment Assistance Act of 1974, as amended.

.7 All federal and state laws and regulations concerning affirmative action toward equal employment opportunities,

.8 All regulations and administrative rules established pursuant to the foregoing laws; and

.9 All other applicable requirements of federal and state civil rights and rehabilitation statutes, rules and regulations.

The Contractor must provide all information and reports required by the Owner, state or federal government having responsibility for the enforcement of such laws upon request, including those required for of investigation into compliance with such laws, regulations and orders.

§ 3.8 Allowances

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents,

- .1 allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- .2 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and
- .3 whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 Superintendent

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

.1 The superintendent may not be replaced without the written consent of the Owner. The Contractor shall be responsible for any additional costs borne by the Owner due to the replacement of the superintendent.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the name and qualifications of a proposed superintendent. Within 14 days of receipt of the information, the Architect may notify the Contractor, stating whether the Owner or the Architect (1) has reasonable objection to the proposed superintendent or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

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§ 3.10 Contractor's Construction and Submittal Schedules

§ 3.10.1 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 contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project.

.1 The Contractor must timely notify the Architect and Owner of changes in the schedule. Any acceptance of the Schedule by the Owner does not constitute agreement by the Owner as to Contractor's sequencing, means, methods, or allocated Contract Time.

.2 In no case shall the Contractor make a request for additional compensation for delays if the Work is completed within the Contract Time, regardless of the Contractor's scheduled time of completion. Any positive difference between the Contractor's scheduled time of completion and the Contract Time is termed "float", and any float will accrue to the Owner for the Owner's benefit.

.3 The parties agree that time is of the essence of this Agreement. The Contractor must at all times carry on the Work diligently, without delay, and punctually fulfill all requirements in the Contract Documents. The Owner shall have the right to accelerate the completion date of the Work, and such acceleration in performance of work will be subject to the Change Order process described in Article 7; however, in circumstances where the acceleration is required due to delays caused by the Contractor or its subcontractors or suppliers, or is the result of a force majeure event, the Contractor shall not be entitled to compensation for such acceleration.

§ 3.10.2 The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Architect's approval. The Architect's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

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

§ 3.11 Documents and Samples at the Site

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Architect and Owner, and delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 Shop Drawings, Product Data and Samples

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment, or workmanship, and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed in

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§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of Separate Contractors.

§ 3.12.6 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.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been approved by the Architect.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals, by the Architect's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such notice, the Architect's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 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 for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures. The Contractor shall not be required to provide professional services in violation of applicable law.

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall be entitled to rely upon the adequacy and accuracy of the performance and design criteria provided in the Contract Documents. The Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional. Shop Drawings, and other submittals related to the Work, designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor the performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review and approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

§ 3.12.10.2 If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Architect at the time and in the form specified by the Architect.

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§ 3.13 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.

§ 3.14 Cutting and Patching

§ 3.14.1 The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting, or patching shall be restored to the condition existing prior to the cutting, fitting, or patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or Separate Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter construction by the Owner or a Separate Contractor except with written consent of the Owner and of the Separate Contractor. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Owner or a Separate Contractor, its consent to cutting or otherwise altering the Work.

§ 3.15 Cleaning Up

§ 3.15.1 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 materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 Access to Work

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

§ 3.17 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.

§ 3.18 Indemnification

§ 3.18.1 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, damage 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 that would otherwise exist as to a party or person described in this Section 3.18. § 3.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner and Architect and their respective Commissioners, consultants, agents, and employees from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, and to defend all claims, proceedings, lawsuits, and judgments arising out of or resulting from performance of the Work, 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; providing however that the Contractor will not be required to indemnify or defend either the Owner or Architect for any liability arising solely out of wrongful acts of the Owner's or Architect's own respective

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officers, employees, or consultants. This indemnification shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 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 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation, or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts.

ARTICLE 4 ARCHITECT

§ 4.1 General

§ 4.1.1 The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

§ 4.1.2 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.

§ 4.2 Administration of the Contract

§ 4.2.1 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.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, 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 the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

§ 4.2.3 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.

§ 4.2.4 Communications

The Owner and Contractor shall include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

.1 The Owner may communicate directly with the Contractor when necessary or appropriate. The Owner may give direction to the Contractor in matters related to access to the site, coordination with Owner's occupancy and use by the public, use of parking and staging areas, use of potentially hazardous products, drug and alcohol policy, no smoking policy, appropriate dress and behavior, safety requirements and safe work practices, where appropriate. The Owner will advise the Architect regarding any communication with or direction given to the Contractor.

§ 4.2.5 Based on the Architect's evaluations 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.

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§ 4.2.6 The Architect and the Owner have have authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, whether or not the Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 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. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5, and 3.12. The Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may order minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site. The Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives.

§ 4.2.11 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's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions rendered in good faith.

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

§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

§ 5.1.1 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. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a Separate Contractor or the subcontractors of a Separate Contractor.

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§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 Award of Subcontracts and Other Contracts for Portions of the Work

§ 5.2.1 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 persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Architect may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

.1 Not later than 30 days after the date of commencement of the Work, the Contractor shall furnish in writing to the Owner through the Architect the names of persons or entities proposed as manufacturers, fabricators or material suppliers for the products, equipment and systems identified in the General Requirements (Division 01 of the Specifications) and, where applicable, the name of the installing Subcontractor.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. 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. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person, or entity for one previously selected if the Owner or Architect makes reasonable objection to such substitution.

.1 The Contractor may only substitute a first-tier subcontractor that was not disclosed under ORS 2790 pursuant to the requirements of ORS 279C.585.

§ 5.3 Subcontractual Relations

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by 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 that the Contractor, by these Contract Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.4 Contingent Assignment of Subcontracts

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

- assignment is effective only after termination of the Contract by the Owner for cause pursuant to .1 Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and
- .2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

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When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 Owner's Right to Perform Construction and to Award Separate Contracts

§ 6.1.1 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.

§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each Separate Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with any Separate Contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to its construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, Separate Contractors, and the Owner until subsequently revised.

.1 The Contractor must cooperate with all other contractors or forces, carry out Work in a way that will minimize interference and delay for all forces involved, place and dispose of materials being sued so as not to interfere with the operations of another, and join the Work with the work of the others in an acceptable manner and in proper sequence to that of the others without additional cost to Owner.

§ 6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces or with Separate Contractors, the Owner or its Separate Contractors shall have the same obligations and rights that the Contractor has under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6, and Articles 10, 11, and 12.

§ 6.2 Mutual Responsibility

§ 6.2.1 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 construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly notify the Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a Separate Contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a Separate Contractor's delays, improperly timed activities, damage to the Work or defective construction.

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§ 6.2.4 The Contractor shall promptly remedy damage that the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or Separate Contractor as provided in Section 10.2.5.

§ 6.2.5 The Owner and each Separate Contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.3 Owner's Right to Clean Up

If a dispute arises among the Contractor, Separate Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

CHANGES IN THE WORK ARTICLE 7

§ 7.1 General

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor, and Architect. A Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor. An order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

§ 7.2 Change Orders

§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor, and Architect stating their agreement upon all of the following:

- .1 The change in the Work;
- .2 The amount of the adjustment, if any, in the Contract Sum; and
- .3 The extent of the adjustment, if any, in the Contract Time.

§ 7.2.2 The Contractor is not entitled to payment, and Owner is not responsible for paying, for overhead and profit under any provision of this Contract, as an allowance or otherwise, which exceeds a combined total under the following Schedule:

.1 For the Contractor, for any Work performed by the Contractor's own forces, a combined amount for overhead and profit equal to the following percent of the cost: 10%.

.2 For the Contractor, for Work performed by the Contractor's Subcontractor, a commission equal to the following percent of the amount due the Subcontractor: 5%.

.3 For each Subcontractor, or Sub-subcontractor involved, for any Work performed by that Subcontractor's or Sub-subcontractor's own forces, a combined amount for overhead and profit equal to the following percent of the cost: 10%.

.4 For each Subcontractor, for Work performed by the Subcontractor's Sub-subcontractor, a commission equal to the following percent of the amount due the Sub-subcontractor: 5%.

Not more than two percentages, not to exceed the maximum percentages shown above, will be allowed for any change regardless of the number of tiers of Subcontractors and Sub-subcontractors; that is, the Contractor's markup on work contracted by a Subcontractor will be limited to one combined overhead and profit percentage in addition to the Contractor's commission percentage.

§ 7.2.3 On Change Order proposals covering both increases and decreases in the amount of the Contract, the overhead, profit, and any commission will be computed on the net dollar amount of the change. On proposals for a net decrease in the amount of the Contract where the reduction in net cost is greater than \$5,000, a deduction of equal percentages for overhead, profit, and any commission must be applied to increase the net reduction in the Contract amount.

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§ 7.3 Construction Change Directives

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

- .1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- .2 Unit prices stated in the Contract Documents or subsequently agreed upon;
- .3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
- .4 As provided in Section 7.3.4.

§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:

- .1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;
- .2 Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;
- .3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
- .4 Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and
- .5 Costs of supervision and field office personnel directly attributable to the change.

§ 7.3.5 If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

§ 7.3.6 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.7 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

.1 The allowance for overhead and profit must be calculated in accordance with the schedule set forth in §7.2.2.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and

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§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. 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. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor shall not proceed to implement the adjustment to the Contract Sum or extension of the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

ARTICLE 8 TIME

§ 8.1 Definitions

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

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

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

§ 8.2 Progress and Completion

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

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 8.3 Delays and Extensions of Time

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by (1) an act or neglect of the Owner or Architect, of an employee of either, or of a Separate Contractor; (2) by changes ordered in the Work; (3) by labor disputes, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner pending mediation and binding dispute resolution; or (5) 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.

.1 The Contractor will not be entitled to extension of the Contract Time on the basis of avoidable delays. Except as otherwise provided in ORS 279C.315, avoidable delays include but are not limited to those delays that could have been avoided by the exercise of care, prudence, foresight, and difgence on the part of the Contractor or its subcontractors, suppliers, or other persons performing Work; delays that affect only a portion of the Work and do not necessarily prevent or delay the prosecution of other parts of the Work nor the completion of the whole Work within the Contract Time; delays that do not impact activities on the accepted critical path schedule; and delays associated with the reasonable interference of other contractors employed by the Owner that do not prevent the completion of the whole work within the Contract Time.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

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ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

§ 9.1.1 The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

§ 9.1.2 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 9.2 Schedule of Values

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit a schedule of values to the Architect before the first Application for Payment, allocating the entire Contract Sum 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, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. Any changes to the schedule of values shall be submitted to the Architect and supported by such data to substantiate its accuracy as the Architect may require, and unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.

§ 9.3 Applications for Payment

§ 9.3.1 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 9.2, for completed portions of the Work. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage if provided for in the Contract Documents.

§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

§ 9.3.1.2 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.

§ 9.3.1.3 Applications for Payment must be accompanied by certified statements regarding the payment of prevailing rates of wage in accordance with ORS 279C.845.

§ 9.3.2 Unless otherwise provided in the Contract Documents, 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 suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage, and transportation to the site, for such materials and equipment stored off the site.

§ 9.3.3 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 encumbrances, in favor of the Contractor, Subcontractors, suppliers, or other persons or entities that provided labor, materials, and equipment relating to the Work.

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§ 9.4 Certificates for Payment

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reasons for withholding certification and Owner of the Architect's reasons for Section 9.5.1; or (3) withhold certification in whole as provided in Section 9.5.1.

.1 Submission of a complete and accurate Application for Payment including supporting data and certified wage statements is a condition precedent to certification of the Application by the Architect and payment by the Owner. If the Application is filled out incorrectly, or contains any defect or impropriety, or lacks the required supporting data or wage statements, or if there is a good faith dispute, the Owner must notify the Contractor within 15 days stating the reason or reasons the Application for Payment is incorrect, defective, incomplete, or disputed.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation 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 that 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.

§ 9.5 Decisions to Withhold Certification

§ 9.5.1 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 9.4.2 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 9.4.1. If the Contractor and 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 3.3.2, because of

- .1—____defective Work not remedied;
- .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.
- .8 Assessment of liquidated damages, to the extent the withholding is made for the purposes of offsetting damages to the Owner; or

.9 Any amounts required to be withheld by a court of competent jurisdiction.

§ 9.5.1.1 Regardless of whether the Contractor may dispute any determination by the Architect with regard to an Application for Payment, the Contractor must continue to expeditiously prosecute the Work. No progress payment made shall be construed to be final acceptance or approval of that portion of the Work to which such partial payment relates or shall relieve Contractor of any of its obligations.

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§ 9.5.3 When the reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.4 If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or supplier to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Contractor shall reflect such payment on its next Application for Payment.

§ 9.6 Progress Payments

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

.1 Payment must be made promptly by the Owner and in accordance with ORS 279C.570. Both the Owner and Contractor will have all the rights and duties specified in ORS 279C.550 through ORS 279C.580 regarding payment. Issuance of a progress payment will not constitute final acceptance or approval of that portion of the Work to which such partial payment relates, nor will such payment relieve Contractor of any of its obligations.

§ 9.6.2 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.

§ 9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

§ 9.6.5 The Contractor's payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 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.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.6.8 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.

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§ 9.7 Failure of Payment

If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents, the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.8 Substantial Completion

§ 9.8.1 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.

.1 No building or facility will be considered substantially complete unless all utilities are connected and operating as required for normal use; the building or facility is accessible by normal vehicular and pedestrian traffic routes; Operation and Maintenance Manuals have been submitted for review to the Architect; and the project has received a Temporary Occupancy Permit from the Building Department.

§ 9.8.2 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.

§ 9.8.3 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. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that 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.

§ 9.8.5 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.

§ 9.9 Partial Occupancy or Use

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor, and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

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§ 9.10 Final Completion and Final Payment

§ 9.10.1 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. 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 listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance 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 the lien, claim, security interest, or encumbrance 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 the lien, claim, security interest, or encumbrance 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 the lien, claim, security interest, or encumbrance payment ar

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

§ 9.10.4 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.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a 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 final Application for Payment.

§ 9.11 Liquidated Damages

The Owner will suffer financial loss if the Work is not Substantially Complete, as defined in Article 8.1.3 of the General Conditions, on the Date set forth in the Contract for the Construction. Since actual damages would be difficult or impossible to determine, it is therefore stipulated that, as a reasonable approximation of actual damages, the Contractor and its Surety shall be liable for and shall pay the Owner, or the Owner may deduct from moneys due the Contractor, the sum of Two Hundred and Fifty Dollars (\$250.00) per calendar day, as fixed, agreed, and liquidated damages for each calendar day of delay until the date appearing on the Certificate of Substantial Completion. Nothing in this provision will limit the actual damages due the Owner,

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if the Owner is able to ascertain and substantiate higher actual damages than the amount stipulated as liquidated damages.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 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.

§ 10.2 Safety of Persons and Property

§ 10.2.1 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.

§ 10.2.2 The Contractor shall comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, bearing on safety of persons or property or their protection from damage, injury, or loss.

§ 10.2.3 The Contractor shall implement, erect, and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of the safeguards.

.1 The Contractor must maintain public and private ways, streets, walks, and drives free from dirt and debris, and ensure that catch basins and drainage systems remain open and free from blockage and siltation.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment, or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 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 10.2.1.2 and 10.2.1.3. 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 anyone directly or indirectly employed by either of them, 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 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 Injury or Damage to Person or Property

If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

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§ 10.3 Hazardous Materials and Substances

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in 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.

§ 10.3.2 Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. 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 by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.

§ 10.3.3 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 10.3.1 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.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

.1 Contractor shall at all times properly handle, use and dispose of all environmental pollutants and hazardous substances or materials brought onto the Work site, in accordance with all applicable federal, state. or local statutes, rules or ordinances; be responsible for and promptly clean up any and all spills, releases, discharges or leaks of such environmental pollutants or hazardous substances or materials, at the Contractor's expense.

§ 10.3.5 The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 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 reimburse the Contractor for all cost and expense thereby incurred subject to the limitations of Article XI, Section 10 of the Oregon Constitution and the Oregon Tort Claims Act.

§ 10.4 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

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ARTICLE 11 **INSURANCE AND BONDS**

§ 11.1 Contractor's Insurance and Bonds

§ 11.1.1 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 the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, and Architect and their respective Commissioners, consultants, agents, and employees Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents.

.1 If the insurance is written on a Commercial General Liability form, the certificate must be an ACORD 25-S certificate.

§ 11.1.2 The Contractor shall provide surety bonds of the types, for such penal sums, and subject to such terms and conditions as required by the Contract Documents. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

.1 The Contractor must furnish Performance Bond and Payment Bond meeting the requirements of ORS 279C.380 covering faithful performance of the Contract and payment of obligations arising thereunder equal to 100% of the Contract Sum. The Contractor shall deliver the required bonds to the Owner not later than the date the Agreement is entered into, or if the work is to be commenced prior thereto in response to a Letter of Intent, the Contractor shall, prior to commencement of the work, submit evidence satisfactory to the Owner that such bonds will be furnished. The Contractor shall require the attorney-in-fact who executed the required bonds on behalf of the surety to affix thereto a certified copy of the Power Of Attorney.

§ 11.1.3 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.

§ 11.1.4 Notice of Cancellation or Expiration of Contractor's Required Insurance. 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 the Contract Documents, 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.

§ 11.2 Owner's Insurance

§ 11.2.1 The Owner 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 the Agreement or elsewhere in the Contract Documents. The Owner shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located.

§ 11.2.2 Failure to Purchase Required Property Insurance. If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere in the Contract Documents, the Owner shall inform the Contractor in writing prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may delay commencement of the Work and may obtain insurance that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the Work. When the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time shall be equitably adjusted. In the event the Owner fails to procure coverage, the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by the Owner. The cost of the insurance shall be charged to the Owner by a Change Order. If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto.

§ 11.2.3 Notice of Cancellation or Expiration of Owner's Required Property Insurance. Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, 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

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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.

§ 11.3 Waivers of Subrogation

§ 11.3.1 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 the 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 11.3.1 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.

§ 11.3.2 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 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.

§ 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance

The Owner, at the Owner's option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner's property, or the inability to conduct normal operations, due to fire or other causes of loss. The Owner waives all rights of action against the Contractor and Architect for loss of use of the Owner's property, due to fire or other hazards however caused.

§11.5 Adjustment and Settlement of Insured Loss

§ 11.5.1 A loss insured under the property insurance required by the Agreement 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 and of Section 11.5.2. The Owner shall pay the Architect and Contractor their just shares of insurance proceeds received by the Owner, and by appropriate agreements the Architect and Contractor shall make payments to their consultants and Subcontractors in similar manner.

§ 11.5.2 Prior to settlement of an insured loss, the Owner shall notify the Contractor of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Contractor shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the Contractor does not object, the Owner shall settle the loss and the Contractor shall be bound by the settlement and allocation. Upon receipt, the Owner shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the damaged or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Owner may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.

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ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

§ 12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the cost of correction, shall be at the Contractor's expense.

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, discovered before 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.

§ 12.2.2 After Substantial Completion

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, 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 9.9.1, or by terms of any 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 and poportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.5.

.1 Correction of all warranty work must be fully coordinated, administered, and supervised by the Contractor.

<u>.2 The Contractor must respond to any warranty item deemed by the Owner to be an emergency item</u> requiring immediate attention within 12 hours of receipt of notification. The Contractor shall respond to all other warranty notifications within 48 hours of receipt of notification.

<u>.3</u> All warranty work must be documented in an approved form and accepted by the Owner in writing. <u>.4</u> 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.

.5 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.2. 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.

§ 12.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner or Separate Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

§ 12.2.6 The one-year period for correction of Work shall be extended for each part of the Work where an extended warranty is called for in the Contract Documents.

§ 12.2.7 Extended warranties are an extension of the one-year warranty called for in the General Conditions and are in addition to any Guarantee Bond called for elsewhere. Warranties for weather-tightness and water-tightness shall include the repair or replacement, at no cost to the Owner, of any building components or contents damaged by the failure of such system or systems to be water-tight or weather-tight. The Owner may when necessary, make temporary or emergency repairs reasonably necessary to maintain the integrity of the structure and its contents.

§ 12.3 Acceptance of Nonconforming Work

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

The Contract will be governed by and construed in accordance with the laws of the State of Oregon without regard to principles of conflict of laws. Any claim between Owner and Contractor that arises from or relates to this Contract and that is not resolved through the Claims Review process, mediation, or any further agreed-upon dispute resolution, must be brought and conducted solely and exclusively within the Circuit Court of Lane County for the State of Oregon; however, if a claim must be brought in a federal forum, then it must be brought and conducted solely and exclusively within the District of Oregon located in Lane County. In no event will this section be construed as a waiver by the Owner of any form of defense or immunity whether governmental immunity or otherwise, from any claim or from the jurisdiction of any courtshall 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 15.4.

§ 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 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 the assignment.

§ 13.3 Rights and Remedies

§ 13.3.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

§ 13.3.2 No action or failure to act by the Owner, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

§ 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and

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§ 13.4.2 If the Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Architect's services and expenses, shall be at the Contractor's expense.

§ 13.4.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect, <u>Contractor</u>, <u>Owner</u>, <u>Building</u> <u>Department</u>, and <u>related Consultants</u>.

§ 13.4.5 If the Architect is to observe tests, inspections, or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.4.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.5 Interest

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate the parties agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located. <u>However, payment due and payable under this Contract will bear interest only as specified in</u> ORS 279C.570.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor, a Subcontractor, a Subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, for any of the following reasons:

- .1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- .2 An act of government, such as a declaration of national emergency, that requires all Work to be stopped;
- .3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or
- .4 The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, repeated suspensions, delays, or interruptions of the entire Work by the Owner as described in Section 14.3, constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, as well as reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination.

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§ 14.2 Termination by the Owner for Cause

§ 14.2.1 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 or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;
- .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.

§ 14.2.2 When any of the reasons described in Section 14.2.1 exist, and upon certification by the Architect that sufficient cause exists to justify such action, the Owner may, without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

- .1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- .2 Accept assignment of subcontracts pursuant to Section 5.4; and
- .3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written 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.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 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 Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.2.5 The Contractor shall, from the effective date of termination until the expiration of three years after final settlement under this Contract, preserve and make available to the Owner, at all reasonable times at the office of the Contractor, and without charge to the Owner, all books, records, documents, photographs and other evidence bearing on the costs and expenses of the Contractor under this Contract and relating to the terminated Work.

§ 14.3 Suspension by the Owner for Convenience

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work, in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

- .1 that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or
- .2 that an equitable adjustment is made or denied under another provision of the Contract.

§ 14.4 Termination by the Owner for Convenience

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause <u>if Owner</u> determines that termination of the Contract is in the best interests of the public. The Owner will provide the Contractor with not less than seven (7) days' prior written notice of such termination. After such notice, Contractor

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§ 14.4.2 Upon receipt of notice from the Owner of such termination for the Owner's convenience, the Contractor shall

- .1 cease operations as directed by the Owner in the notice;
- .2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and
- .3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly executed; costs incurred by reason of the termination, including costs attributable to termination of Subcontracts; and the termination fee, if any, set forth in the Agreement.

§ 14.4. As directed by Owner, Contractor shall upon termination transfer title and deliver to the Owner all Record Documents, information, and other property that, if the Contract had been completed, would have been required to be furnished to the Owner.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

§ 15.1.2 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, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and 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 15.1.2.

§ 15.1.3 Notice of Claims

§ 15.1.3.1 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 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated 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.

§ 15.1.3.2 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 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

§ 15.1.4 Continuing Contract Performance

§ 15.1.4.1 Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

§ 15.1.4.2 The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

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§ 15.1.5 Claims for Additional Cost

If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.6 Claims for Additional Time

§ 15.1.6.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

§ 15.1.6.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated, and had an adverse effect on the scheduled construction.

.1 Adverse weather conditions, for the purpose of this Contract, are those which surpass in severity the weather reasonably to be expected in this area during the time of year involved.

§ 15.1.6.3 A claim for cost due to additional time will be considered if the actual cost is substantiated in writing for each occurrence as required in 7.3.7. However, so long as the additional time does not exceed the Date of Completion indicated in the Contract, no claim for cost due to additional time shall be accepted.

§ 15.1.6.4 Claims for increase in the Contract Time shall set forth in detail the circumstances that form the basis for the Claim, the date upon which each cause of delay began to affect the progress of the Work, the date upon which each cause of delay ceased to affect the progress of the Work and the number of days' increase in the Contract Time claimed as a consequence of each such cause of delay. The Contractor shall provide such supporting documentation as the Owner may require including, where appropriate, a revised construction schedule indicating all the activities affected by the circumstances forming the basis of the Claim.

§ 15.1.7 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 14. Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 Initial Decision

§ 15.2.1 Claims, excluding those 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 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim. If an initial decision has not been rendered within 30 days after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution without a decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

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§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

§ 15.2.6.1 Either party may, within 30 days from the date of receipt of an initial decision, demand in writing that the other party file for mediation. If such a demand is made and the party receiving the demand fails to file for mediation within 30 days after receipt thereof, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3 Mediation

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract, except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.7, shall be subject to mediation as a condition precedent to binding dispute resolution.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings 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 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 15.3.3 Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.

§ 15.3.4 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

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§ 15.4 Arbitration

§ 15.4.1 If the parties have selected arbitration as the method for binding dispute resolution in the 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 its Construction Industry Arbitration Rules in effect on the date of the Agreement. The Arbitration shall be conducted in the place where the Project is located, unless another location is mutually agreed upon. A 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 party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

§ 15.4.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

§ 15.4.2 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.

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

§ 15.4.4 Consolidation or Joinder

§ 15.4.4.1 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party 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).

§ 15.4.4.2 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party 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 any claim, dispute or other matter in question not described in the written consent.

§ 15.4.4.3 The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as those of the Owner and Contractor under this Agreement.



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AIA Document A310[°] – 2010

Bid Bond

CONTRACTOR:

(Name, legal status and address)

SURETY:

(Name, legal status and principal place of business)

OWNER: *(Name, legal status and address)*

BOND AMOUNT: \$

Init.

1

PROJECT: *(Name, location or address, and Project number, if any)*

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

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

1

The Contractor and Surety are bound to the Owner in the amount set forth above, for the payment of which the Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, as provided herein. The conditions of this Bond are such that if the Owner accepts the bid of the Contractor within the time specified in the bid documents, or within such time period as may be agreed to by the Owner and Contractor, and the Contractor either (1) enters into a contract with the Owner in accordance with the terms of such bid, and gives such bond or bonds as may be specified in the bidding or Contract Documents, with a surety admitted in the jurisdiction of the Project and otherwise acceptable to the Owner, for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof; or (2) pays to the Owner the difference, not to exceed the amount of this Bond, between the amount specified in said bid and such larger amount for which the Owner may in good faith contract with another party to perform the work covered by said bid, then this obligation shall be null and void, otherwise to remain in full force and effect. The Surety hereby waives any notice of an agreement between the Owner and Contractor to extend the time in which the Owner may accept the bid. Waiver of notice by the Surety shall not apply to any extension exceeding sixty (60) ninety (90) days in the aggregate beyond the time for acceptance of bids specified in the bid documents, and the Owner and Contractor shall obtain the Surety's consent for an extension beyond sixty (60) ninety (90) days.

If this Bond is issued in connection with a subcontractor's bid to a Contractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

When this Bond has been furnished to comply with a statutory or other legal requirement in the location of the Project, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

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Signed and sealed this day of ,

	(Contractor as Principal)	(Seal)
(Witness)	(Title)	
	(Surety)	(Seal)
(Witness)	(Title)	

Init. 1

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(Signed) (Title) (Dated)			
(Title) (Dated)	(Signed)		
(Title) (Dated)			
(Dated)	(Title)		
(Dated)			
	(Dated)		

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${}^{\textcircled{\sc w}}AIA^{\sc w}$ Document A312^{\square} – 2010

Performance Bond

CONTRACTOR:

(Name, legal status and address)

SURETY:

(Name, legal status and principal place of business)

OWNER:

(Name, legal status and address)

CONSTRUCTION CONTRACT Date: Amount: \$ 0.00 Description: (Name and location)

BOND

Date: (Not earlier than Construction Contract Date)

Amount: \$ Modifications to this Bond: None See Section 16

CONTRACTOR AS PRINCIPAL SURETY (Corporate Seal) Company: (Corporate Seal) Company: Signature: Signature: Name and Name and Title: Title: (Any additional signatures appear on the last page of this Performance Bond.)

(FOR INFORMATION ONLY — Name, address and telephone) **OWNER'S REPRESENTATIVE:** AGENT or BROKER: (Architect, Engineer or other party:) This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

Init. 1

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§ 1 The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

§2 If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Section 3.

§ 3 If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after

- .1 the Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Section 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default;
- .2 the Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and
- .3 the Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

§ 4 Failure on the part of the Owner to comply with the notice requirement in Section 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

§ 5 When the Owner has satisfied the conditions of Section 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

§ 5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

§ 5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

§ 5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Section 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

§ 5.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor and with reasonable promptness under the circumstances:

- .1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as
 - practicable after the amount is determined, make payment to the Owner; or
- .2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

§ 6 If the Surety does not proceed as provided in Section 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Section 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

§7 If the Surety elects to act under Section 5.1, 5.2 or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the

Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication, for

- .1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;
- .2 additional legal, design professional and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Section 5; and
- .3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

§8 If the Surety elects to act under Section 5.1, 5.3 or 5.4, the Surety's liability is limited to the amount of this Bond.

§ 9 The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors and assigns.

§ 10 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

§ 11 Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

§ 12 Notice to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

§ 13 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

§ 14 Definitions

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§ 14.1 Balance of the Contract Price. The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made, including allowance to the Contractor of any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

§ 14.2 Construction Contract. The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

§ 14.3 Contractor Default. Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

§ 14.4 Owner Default. Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

§ 14.5 Contract Documents. All the documents that comprise the agreement between the Owner and Contractor.

§ 15 If this Bond is issued for an agreement between a Contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

3

§ 16 Modifications to this bond are as follows:

CONTRACTOR AS PRINCIPAL		SURETY	
Company:	(Corporate Seal)	Company:	(Corporate Seal)
Signature:		Signature:	
Name and Title:		Name and Title:	
Address:		Address:	

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(Signed)			
(Title)			
(Dated)			

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Payment Bond

CONTRACTOR:

(Name, legal status and address)

SURETY:

(Name, legal status and principal place of business)

OWNER: (Name, legal status and address)

CONSTRUCTION CONTRACT Date: Amount: \$ 0.00 Description: (Name and location) <u>..</u>

BOND

Date: (Not earlier than Construction Contract Date)

Amount: \$ Modifications to this Bond: See Section 18 None

CONTRACTOR AS PRINCIPAL SURETY Company: (Corporate Seal) Company: (Corporate Seal)

Signature: Signature: Name and Name and Title: Title: (Any additional signatures appear on the last page of this Payment Bond.)

(FOR INFORMATION ONLY — Name, address and telephone) AGENT or BROKER: **OWNER'S REPRESENTATIVE:**

(Architect, Engineer or other party:)

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

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

Init. 1

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$\textcircled{B}{AIA}^{*} \text{ Document G701}^{*} - 2017$

Change Order

PROJECT: (Name and address)	CONTRACT INFORMATION: Contract For: Date:	CHANGE ORDER INFORMATION: Change Order Number: 001 Date:
OWNER: (Name and address)	ARCHITECT: (Name and address)	CONTRACTOR: (Name and address)

THE CONTRACT IS CHANGED AS FOLLOWS:

(Insert a detailed description of the change and, if applicable, attach or reference specific exhibits. Also include agreed upon adjustments attributable to executed Construction Change Directives.)

The original Contract Sum was \$;	0.00
The net change by previously authorized Change Orders \$;	0.00
The Contract Sum prior to this Change Order was	;	0.00
The Contract Sum will be increased by this Change Order in the amount of \$;	0.00
The new Contract Sum including this Change Order will be \$; _	0.00
The Contract Time will be increased by Zero (0) days.		

The new date of Substantial Completion will be

NOTE: This Change Order does not include adjustments to the Contract Sum or Guaranteed Maximum Price, or the Contract Time, that have been authorized by Construction Change Directive until the cost and time have been agreed upon by both the Owner and Contractor, in which case a Change Order is executed to supersede the Construction Change Directive.

NOT VALID UNTIL SIGNED BY THE ARCHITECT, CONTRACTOR AND OWNER.

ARCHITECT (Firm name)	CONTRACTOR (Firm name)	OWNER (Firm name)
SIGNATURE	SIGNATURE	SIGNATURE
PRINTED NAME AND TITLE	PRINTED NAME AND TITLE	PRINTED NAME AND TITLE
DATE	DATE	DATE

Application and Certificate for P	ayment		
TO OWNER:	PROJECT:		APPLICATION NO: 001 PERIOD TO: 001 CONTRACT FOD: 0
FROM CONTRACTOR:	VIA ARCHITECT:		CONTRACT DATE: CONTRACT DATE: PROJECT NOS: / / CONTRACTOR: [FIELD: [OTHER : [
CONTRACTOR'S APPLICATION FOR Application is made for payment, as shown below, in co Continuation Sheet, AIA Document G703, is attached.	PAYMENT nnection with the Con	tract.	The undersigned Contractor certifies that to the best of the Contractor's knowledg information and belief the Work covered by this Application for Payment has bee completed in accordance with the Contract Documents, that all amounts have been pai by the Contractor for Work for which previous Certificates for Payment were issued ar
1. OKIGINAL CONTRACT SUM		\$0.00 \$0.00	payments received from the Owner, and that current payment shown herein is now due. CONTRACTOR: By:
4. TOTAL COMPLETED & STORED TO DATE (Column G o	on G703)	\$0.00	State of:
 5. RETAINAGE: a. 0 % of Completed Work (Column D + E on G703) b. 0 % of Second Material 		\$0.00	County of: Subscribed and sworn to before me this day of
Column F on G703) (Column F on G703) Total Retainage (Lines 5a + 5b or Total in Column I	of G703)	<u>\$0.00</u> \$0.00	Notary Public: My Commission expires:
6. TOTAL EARNED LESS RETAINAGE		\$0.00	ARCHITECT'S CERTIFICATE FOR PAYMENT
(Line 4 Less Line 5 Total)7. LESS PREVIOUS CERTIFICATES FOR PAYMENT(Line 6 from prior Certificate)		\$0.00	In accordance with the Contract Documents, based on on-site observations and the da comprising this application, the Architect certifies to the Owner that to the best of the Architect's knowledge, information and belief the Work has progressed as indicated, the quality of the Work is in accordance with the Contract Documents, and the Contractor
8. CURRENT PAYMENT DUE		\$0.00	entitled to payment of the AMOUNI CERTIFIED.
9. BALANCE TO FINISH, INCLUDING RETAINAGE (Line 3 less Line 6)		<u>\$0.00</u>	AMOUNT CERTIFIED
CHANGE ORDER SUMMARY Total changes annroved in nrevious months by Owner	ADDITIONS	DEDUCTIONS	ARCHITECT:
Total approved this Month	\$0.00 \$0.00	\$0.00 \$0.00	DyUate:
101ALS NET CHANGES by Change Order	\$0.00	\$0.00	named herein. Issuance, payment and acceptance of payment are without prejudice to any rights the Owner or Contractor under this Contract.
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M = M = M = 1992 Document G702Th - 1992

MIA Document G703Th – 1992

Continuation Sheet

AIA Do	ocument, G702 TM -1992, <i>i</i>	Application and Ce	ertification for Payn	nent, or G736 TM –2	009,	APPLICATION NO:		001	
Project contain	Application and Project (ing Contractor's signed ce	Certificate for Payn artification is attacl	ment, Construction	Manager as Advise	er Edition,	APPLICATION DATE:			
In tabu	ations below, amounts ar	e in US dollars.				PERIOD TO:			
Use Co	lumn I on Contracts wher	e variable retaina£	ge tor line items ma	y appiy.		ARCHITECT'S PROJECT	NO:		
Α	В	С	D	Е	F	G		Н	Ι
			WORK COI	MPLETED	MATERIALS	TOTAL	č	BALANCE TO	RETAINAGE
NO.	DESCRIPTION OF WORK	SCHEDULED VALUE	FROM PREVIOUS APPLICATION (D + E)	THIS PERIOD	PRESENILY STORED (NOT IN D OR E)	COMPLETED AND STORED TO DATE (D + E + F)	% (G ÷C)	FINISH (C - G)	(IF VARIABLE RATE)
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		00.0	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
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		0.00	0.00	00.00	0.00	00.00	0.00%	0.00	0.00
		0.00	0.00	00.0	0.00	0.00	0.00%	00.0	0.00
		0.00	0.00	00.0	0.00	00.0	0.00%	00.0	0.00
		0.00	0.00	00.0	0.00	00.00	0.00%	0.00	0.00
		0.00	0.00	00.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	00.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	00.0	0.00	00.0	0.00%	00.0	0.00
		0.00	0.00	00.0	0.00	0.00	0.00%	00.0	0.00
		0.00	0.00	00.00	0.00	0.00	0.00%	00.0	0.00
		0.00	0.00	00.0	0.00	00.0	0.00%	00'0	0.00
		00.0	0.00	00.0	00.00	00.0	0.00%	00'0	0.00
		0.00	0.00	00.0	0.00	00.0	0.00%	00.0	0.00
		0.00	0.00	00.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	00.00	0.00	0.00	0.00%	0.00	0.00
	GRAND TOTAL	S0.00	80.00	20.00	80.00	80.00	0.00%	00.02	80.00

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(3B9ADA83)

User Notes:

Certificate of Substantial Completion

PROJECT: (name and address)

CONTRACT INFORMATION: Contract For: Date:

CERTIFICATE INFORMATION: Certificate Number: 001 Date:

OWNER: (name and address)

ARCHITECT: (name and address)

CONTRACTOR: (name and address)

The Work identified below has been reviewed and found, to the Architect's best knowledge, information, and belief, to be substantially complete. Substantial Completion is the stage in the progress of the Work when the Work or designated portion is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use. The date of Substantial Completion of the Project or portion designated below is the date established by this Certificate. *(Identify the Work, or portion thereof, that is substantially complete.)*

ARCHITECT (Firm Name)

SIGNATURE

PRINTED NAME AND TITLE

DATE OF SUBSTANTIAL COMPLETION

WARRANTIES

The date of Substantial Completion of the Project or portion designated above is also the date of commencement of applicable warranties required by the Contract Documents, except as stated below:

(Identify warranties that do not commence on the date of Substantial Completion, if any, and indicate their date of commencement.)

WORK TO BE COMPLETED OR CORRECTED

A list of items to be completed or corrected is attached hereto, or transmitted as agreed upon by the parties, and identified as follows: *(Identify the list of Work to be completed or corrected.)*

The failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents. Unless otherwise agreed to in writing, the date of commencement of warranties for items on the attached list will be the date of issuance of the final Certificate of Payment or the date of final payment, whichever occurs first. The Contractor will complete or correct the Work on the list of items attached hereto within () days from the above date of Substantial Completion.

Cost estimate of Work to be completed or corrected: \$

The responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work, insurance, and other items identified below shall be as follows:

(Note: Owner's and Contractor's legal and insurance counsel should review insurance requirements and coverage.)

The Owner and Contractor hereby accept the responsibilities assigned to them in this Certificate of Substantial Completion:

CONTRACTOR (Firm Name)	SIGNATURE	PRINTED NAME AND TITLE	DATE
OWNER (Firm Name)	SIGNATURE	PRINTED NAME AND TITLE	DATE

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$\operatorname{AIA}^{\circ}$ Document G706TH – 1994

Contractor's Affidavit of Payment of Debts and Claims

PROJECT: (Name and address)	ARCHITECT'S PROJECT NUMBER:	OWNER: 🗌
		ARCHITECT: 🗌
	CONTRACT FOR:	CONTRACTOR: 🗌
TO OWNER: (Name and address)	CONTRACT DATED:	SURETY: 🗌
		OTHER:

STATE OF: COUNTY OF:

The undersigned hereby certifies that, except as listed below, payment has been made in full and all obligations have otherwise been satisfied for all materials and equipment furnished, for all work, labor, and services performed, and for all known indebtedness and claims against the Contractor for damages arising in any manner in connection with the performance of the Contract referenced above for which the Owner or Owner's property might in any way be held responsible or encumbered.

EXCEPTIONS:

SUPPORTING DOCUMENTS ATTACHED HERETO:

Consent of Surety to Final Payment. Whenever 1. Surety is involved, Consent of Surety is required. AIA Document G707, Consent of Surety, may be used for this purpose Indicate Attachment X Yes No No

The following supporting documents should be attached hereto if required by the Owner:

1. Contractor's Release or Waiver of Liens, conditional upon receipt of final payment.

2. Separate Releases or Waivers of Liens from Subcontractors and material and equipment suppliers, to the extent required by the Owner, accompanied by a list thereof.

3. Contractor's Affidavit of Release of Liens (AIA Document G706A).

CONTRACTOR: (Name and address)

BY:

(Signature of authorized representative)

(*Printed name and title*)

Subscribed and sworn to before me on this date:

Notary Public: My Commission Expires:

Contractor's Affidavit of Release of Liens

PROJECT: (Name and address)	ARCHITECT'S PROJECT NUMBER:	OWNER:
	CONTRACT FOR:	ARCHITECT:
TO OWNER: (Name and address)	CONTRACT DATED:	CONTRACTOR:
		SURETY:
		OTHER:

STATE OF: COUNTY OF:

The undersigned hereby certifies that to the best of the undersigned's knowledge, information and belief, except as listed below, the Releases or Waivers of Lien attached hereto include the Contractor, all Subcontractors, all suppliers of materials and equipment, and all performers of Work, labor or services who have or may have liens or encumbrances or the right to assert liens or encumbrances against any property of the Owner arising in any manner out of the performance of the Contract referenced above.

EXCEPTIONS:

SUPPORTING DOCUMENTS ATTACHED HERETO:

- 1. Contractor's Release or Waiver of Liens, conditional upon receipt of final payment.
- 2. Separate Releases or Waivers of Liens from Subcontractors and material and equipment suppliers, to the extent required by the Owner, accompanied by a list thereof.

CONTRACTOR: (Name and address)

BY:

(Signature of authorized representative)

(Printed name and title)

1

Subscribed and sworn to before me on this date:

Notary Public: My Commission Expires:

${\ensuremath{\underbrace{\bullet}}} AIA^{\ensuremath{\circ}}$ Document G707^{\mathty} – 1994

Consent Of Surety to Final Payment

PROJECT: (Name and address)	ARCHITECT'S PROJECT NUMBER:	OWNER:
	CONTRACT FOR:	ARCHITECT:
		CONTRACTOR:
TO OWNER: (Name and address)	CONTRACT DATED:	SURETY:
		OTHER: 🗌

In accordance with the provisions of the Contract between the Owner and the Contractor as indicated above, the (*Insert name and address of Surety*)

on bond of (Insert name and address of Contractor)

hereby approves of the final payment to the Contractor, and agrees that final payment to the Contractor shall not relieve the Surety of any of its obligations to (Insert name and address of Owner)

as set forth in said Surety's bond.

IN WITNESS WHEREOF, the Surety has hereunto set its hand on this date: (Insert in writing the month followed by the numeric date and year.)

(Surety)

(Signature of authorized representative)

, SURETY,

, CONTRACTOR,

, OWNER,

1

Attest: (Seal):

(Printed name and title)

▲ AIA[®] Document G707A[™] – 1994

Consent of Surety to Reduction in or Partial Release of Retainage

PROJECT: (Name and address)	ARCHITECT'S PROJECT NUMBER:	OWNER:	
	CONTRACT FOR:	ARCHITECT:	
TO OWNED: (Name and address)		CONTRACTOR:	
TO OWNER: (Ivame and address)	CONTRACT DATED:	SURETY:	
		OTHER:	
In accordance with the provision above, the (Insert name and address of Sure	s of the Contract between the Owner and <i>ety)</i>	the Contractor as indicated	
		SURET	Y.
on bond of	turator	,	-,
(Insert name and dataress of Con			
hereby approves the reduction in	or partial release of retainage to the Cont	, CONTRACTO	R,
The Surety agrees that such redu the Surety of any of its obligation (Insert name and address of Own	ction in or partial release of retainage to t ns to <i>ner</i>)	he Contractor shall not relieve	
		, OWNE	R,
as set forth in said Surety's bond.			
IN WITNESS WHEREOF, the S (Insert in writing the month follo	Surety has hereunto set its hand on this date wed by the numeric date and year.)	te:	
		(Surety)	
		(Signature of authorized representative)	
Attest:			
(Seal):		(Printed name and title)	

$\operatorname{AIA}^{\circ}$ Document G710^{TI} – 2017

Architect's Supplemental Instructions

PROJECT: (name and address)

CONTRACT INFORMATION: Contract For: Date:

ASI INFORMATION: ASI Number: 001 Date:

OWNER: (name and address)

ARCHITECT: (name and address)

CONTRACTOR: (name and address)

The Contractor shall carry out the Work in accordance with the following supplemental instructions without change in Contract Sum or Contract Time. Proceeding with the Work in accordance with these instructions indicates your acknowledgment that there will be no change in the Contract Sum or Contract Time. (Insert a detailed description of the Architect's supplemental instructions and, if applicable, attach or reference specific exhibits.)

ISSUED BY THE ARCHITECT:

ARCHITECT (Firm name)

SIGNATURE

PRINTED NAME AND TITLE

DATE

$\operatorname{AIA}^{\circ}$ Document G714^T – 2017

Construction Change Directive

PROJECT: (name and address)	CONTRACT INFORMATION: Contract For: Date:	CCD INFORMATION: Directive Number: 001 Date:
OWNER: (name and address)	ARCHITECT: (name and address)	CONTRACTOR: (name and address)

The Contractor is hereby directed to make the following change(s) in this Contract: (Insert a detailed description of the change and, if applicable, attach or reference specific exhibits.)

PROPOSED ADJUSTMENTS

- The proposed basis of adjustment to the Contract Sum or Guaranteed Maximum Price is: 1. Lump Sum decrease of \$0.00 Unit Price of \$ per Cost, as defined below, plus the following fee: (Insert a definition of, or method for determining, cost)
 - As follows:
- 2. The Contract Time is proposed to . The proposed adjustment, if any, is ().

NOTE: The Owner, Architect and Contractor should execute a Change Order to supersede this Construction Change Directive to the extent they agree upon adjustments to the Contract Sum, Contract Time, or Guaranteed Maximum price for the change(s) described herein.

When signed by the Owner and Architect and received by the Contractor, this document becomes effective IMMEDIATELY as a Construction Change Directive (CCD), and the Contractor shall proceed with the change(s) described above.			
OWNER (Firm name)	CONTRACTOR (Firm name)		
SIGNATURE	SIGNATURE		
PRINTED NAME AND TITLE	PRINTED NAME AND TITLE		
DATE	DATE		
	ct and received by the Contractor, this document a Construction Change Directive (CCD), and the e(s) described above. OWNER (Firm name) SIGNATURE PRINTED NAME AND TITLE DATE		

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Appendix B

Geotechnical Design Report



GEOTECHNICAL DESIGN REPORT ROGUE VALLEY TRANSPORTATION DISTRICT T37S, R1W, SECTION 8CC, TL 800 3200 CRATER LAKE AVENUE MEDFORD, OREGON

- For: Nick Black Maintenance Manager Rogue Valley Transportation District 3200 Crater Lake Avenue Medford, OR 97526
- By: THE GALLI GROUP 612 NW Third Street Grants Pass, OR 97526 (541) 955-1611

02-6139-01 July 29, 2022

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GEOTECHNICAL DESIGN REPORT ROGUE VALLEY TRANSPORTATION DISTRICT T37S, R1W, SECTION 8CC, TL 800 3200 CRATER LAKE AVENUE MEDFORD, OREGON

1.0 INTRODUCTION

This report presents the results of our geotechnical evaluation of the site for the proposed new administrative building and parking garage for Rogue Valley Transportation District. The property is located on the north side of Forest Hills Drive, east of its intersection with Crater Lake Avenue in Medford, Oregon. Please see *Figure 1, Vicinity Map* and *Figure 2, Tax Lot Map* for a precise site location.

The purpose of this investigation and report was to evaluate the site surface and subsurface conditions with a series of two (2) exploratory borings, four (4) shallow test pits, six (6) deep test pits and review of geologic information at and near the site, in order to provide geotechnical recommendations for design and construction of the proposed development, including building foundations, retaining walls, drive lanes and parking areas.

2.0 SITE AND PROJECT DESCRIPTION

The subject development site is located on the north side of Forest Hills Drive, east of its intersection with Crater Lake Avenue in Medford, Oregon. This 1.38-acre lot is bounded by the existing Rogue Valley Transportation District Facilities to the north, residential development to the east, private commercial property to the west and Forest Hills Drive to the south. The lot is generally flat. The northern two-thirds of the lot consists of a parking lot area with coarse gravel and cobble surfacing. This area of the site slopes gently (approximately 2%) down to the north towards the Hopkins Canal irrigation ditch, which runs along the north property boundary. The southern one-third of the lot is slightly higher in elevation (1-2 feet) and covered with grass and gravel surfaces and three large stockpiles of rock, soil and concrete. This portion of the site slopes gently to the south towards Forest Hills Drive.

We understand the project consists of constructing a new, 2-story, administrative structure in the northeast portion of the lot and a 2-story, partially embedded parking garage in the majority of the south half of the lot. Other site development consists of asphalt parking, access lanes and stormwater drainage facilities. Associated walkways, landscaping and fencing will also be included.

We assume the proposed administrative structure will be constructed using standard wood or metal framing and will have a full second floor. The parking garage structure will be constructed of concrete and will likely be partially embedded. Both structures will have slab-on-grade floors supported on concrete foundations with isolated piers and continuous footings. We understand that loads are expected to be up to 600 kips on isolated footings and up to 40 kips per lineal foot of continuous footings. No underground levels are planned for the administrative building.

3.0 FIELD EXPLORATION

3.1 SUBSURFACE INVESTIGATION

On June15, 2022, Project Engineer, Lyn Chand, P.E., visited the site with our drilling crew members to accomplish the subsurface investigation using our ATV mounted drill rig. Several attempts were made to advance the borings through the existing, surficial layers of undocumented rock fill which covers nearly the entire site. The types of fill materials we encountered appeared to be densely compacted and varied in consistency. ranging from ³/₄" minus to 4" minus crushed rock and, in some areas, gravel and cobble sized pieces of brick and concrete. After numerous attempts we were able to penetrate the undocumented fill layers at the Boring B-5 location, and advance drilling into the underlying dense, light brown, Sand (top of highly weathered Sandstone). We were only able to penetrate approximately 1-foot into the fill at the B-8 location and were unable to collect a sample from SPT testing. Several additional boring attempts were made before it was determined that test pit exploration would be necessary. A Kubota mini excavator was onsite and Dan, with RVTD, excavated shallow test pits in four locations (TP-1 through TP-4) within the northern portion of the lot. These test pits were excavated to depths from 1.3 to 3.5 feet below the surface. Concrete debris was encountered at shallow depths below the 4-inch crushed rock surface. Samples were collected and a larger excavator was scheduled to continue subsurface exploration. On June 22, 2022, Lyn returned with Ed Starner Excavation and 6 additional test pits were excavated to depths ranging from 2.5 to 11.5 feet. All exploration locations are shown on Figure 3, Site Plan with Exploration Locations.

Borings and test pits were located across the site, around surface obstructions, near proposed structures. Borings were advanced with sample collection and testing being accomplished at various depths. Shallow test pits were used for surface evaluation and deeper test pits were excavated to dense bedrock units. All borings and test pits were refilled with excavation spoils. Standard Penetration Testing (SPT) was accomplished in the borings. This entails driving a 1¹/₂-inch diameter steel split spoon sampler by dropping a 140-pound weight for a 30-inch drop. The total number of blows it takes to drive the sampler the last 12 inches of an 18-inch drive is called the SPT N-value. These can be correlated with soil strength parameters from testing on thousands of other projects.

Our representative identified the exploration locations, logged subsurface soils and water conditions and obtained soil samples for transport to our laboratory. Visual classifications of the soils were made in the field and are presented in the *Appendix A*, *Boring and Test Pit Logs*, at the end of this report.

3.2 PERMEABILITY FIELD TESTING (OMITTED)

Due to numerous surface obstructions (shipping containers, vehicles, material stockpiles, etc.), surficial fill layers with constructions debris (across the entire site), the presence of shallow, impermeable sandstone (at 3-4 feet deep) located on the southern half of the lot and impermeable expansive clay soils (up to 7 feet deep) on the northern half of the lot, as well as significant seepage near the northern boundary of the property (see TP-9 and TP-10), permeability testing was not conducted at this site. From extensive experience with both sandstone and expansive clay soils, permeability is historically very low within these geologic units. In addition, the USGS Web Soil Survey classifies the site soils as Coker Clay (Unit 33A) which is considered Hydrologic Group D. *"Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission." (USGS Web Soil Survey, 2022).*

4.0 LABORATORY TESTING

Soil samples collected during our investigation were all tested for natural moisture content. Select samples were chosen for various types of additional testing as part of the laboratory component for this project. The resulting laboratory data was used for site soils classifications, site evaluation, settlement and seismic calculations and for providing the geotechnical design recommendations in this report. See the laboratory testing summary in the following table. Full laboratory test results are presented in *Appendix B*.

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Laboratory Testing Summary Table				
Sample	Depth	Soil Description	Test Type	Results
	(ft.)			
TP-7, S-2	3.0-4.0	sandy Clay	Atterberg Limits	CH
TP-10, S-1	4.0-5.0	silty Clay	Atterberg Limits	СН
TP-10, S-2	9.0-10.0	sandy Silt	Atterberg Limits	ML
TP-3, S-1	0.7-1.3	silty Clay	Expansive Index	$EI_{50}=91$
TP-4, S-2	2.5-3.0	sandy Clay	Expansive Index	$EI_{50}=57$
B-5, S-1	2.5-3.0	silty Sand	Sieve Analysis	SM (69%) Sand/Gravel
TP-5, S-1	1.5-2.0	clayey Sand	Sieve Analysis	SC (65%) Sand/Gravel
TP-7, S-3	9.0-10.0	clayey Gravel	Sieve Analysis	GC (58%) Sand/Gravel
TP-10, S-1	4.0-5.0	sandy Clay	Sieve Analysis	CH (68%) Silt/Clay
TP-8, S-2	3.0-3.5	sandy Clay	Sieve w/Hydrometer	CH (75%) Silt/Clay
TP-9, S-1	2.0-2.5	Clay	Sieve w/Hydrometer	CH (86%) Silt/Slay
TP-10. S-2	9.0-10.0	clayey, sandy Silt	Sieve w/Hydrometer	ML (58%) Silt/Clay

5.0 SUBSURFACE CONDITIONS

5.1 SOIL

The site areas investigated were covered with a surficial fill layer, which extended from 8 inches to 4 feet in depth and contained various materials, including crushed rock, concrete debris, plastic debris and soil fill. On the northern half of the lot scattered large concrete debris was found at the bottom of the fill layer and in the top 12-inches of native clay.

The medium stiff to stiff, expansive clay soils beneath the fill on the northern half of the lot extend to depths ranging from 3.0' to 7.5' below the surface before transitioning to the underlying medium dense to very dense clayey Sands or clayey Gravels. The highly weathered Sandstone and/or Basalt bedrock below the fill and native soils layers was encountered at various depths across the site. In general, the southwest portion of the lot encountered the weathered bedrock directly beneath the fill materials at depths of between 2.5 to 4.0 feet below the surface. The depth to the weathered bedrock was encountered at 5.5 and 7.5 feet in TP-9 and TP10, respectively, at the north end of the site and at 11.0 feet in TP-7 on the east edge of the site.

Please see more specific soils information in the Boring and Test Pit Logs in *Appendix A*. Please note that the soils are shown as distinct layers in the Logs while in nature they may change more gradually. Soils conditions may vary considerably between the locations investigated.

5.2 GROUNDWATER

The majority of the test pits and borings encountered damp to moist soils. No free water (groundwater) was encountered in any of the borings. However, groundwater seepage

zones were encountered in the two test pits accomplished near the north edge of the site (TP-9 and TP-10). Depths to the seepage zones were 5.5 feet and 3.0 feet, respectively. The source of the shallow seepage is likely due to the presence of the Hopkins Water Canal that runs along the northern property boundary. Due to the low permeability of the expansive clay soils and shallow Sandstone bedrock encountered across much of the site, subsurface seepage or a perched water zone may be present at the soil/rock interface during wet weather months. In some areas of the site, surface soils will likely become wet or saturated and disturbed during wet weather months.

Site dewatering will may be required to mitigate the impact of groundwater seepage into excavations during construction of the project. However, the upper soils are not highly permeable so we anticipate only moderate seepage rates, which can likely be handled with sumps during construction. Also, we highly recommend using footing drains, wall drains and floor subdrains where new structures (parking lot structure) are embedded into the subsurface soils and to mitigate the impact of groundwater migration to the existing below-grade floors on a long-term basis. Additional drainage recommendations will be provided in the following sections of this report.

6.0 GEOLOGIC HAZARDS AND SEISMICITY

6.1 REGIONAL GEOLOGIC SETTING

The project area is located near the eastern boundary of Medford, Oregon. The site is at the eastern edge of Oregon's Klamath Mountain physiographic province, with the Cascade Volcanic Physiographic Province beginning in the foothills approximately two miles east of the project site.

The Klamath Mountain province consists of exotic terranes originating in island archipelago environments during the Paleozoic to Mesozoic Eras. The terranes were transported eastward by plate motions, where they were accreted as individual eastdipping lithologic units against the North American Plate. Accretion of the terranes began in middle to late Jurassic and ended by early Cretaceous Period. The province contains several northeast trending intrusive granitic belts which were typically intruded after accretion of the individual terranes. The Mount Ashland, Gold Hill, Jacksonville, and Grants Pass plutons are examples of the intrusive units. Seven individual terranes are identified in the Klamath Province, which covers approximately 12,000 square miles in northern California and southern Oregon (Orr and Orr, 2012).

The Western Cascade sub-province of Oregon's Cascade Physiographic Province begins in the foothills approximately 3.5 miles east of the project site. Deposition of the Western Cascade volcanic units in this region began in early Oligocene (approximately 36 million years ago) period, and ended in early to middle Miocene (approximately 25 million years ago) period, (Wiley and Smith, 1993). The Western Cascades are faulted and mildly folded and have a regional dip of 10-15 degrees to the east. Softer volcanic units are highly dissected and drainages are well established along the more easily eroded geologic units. Oregon's Klamath Mountain province experienced regional uplift and faulting into the Tertiary Period. Faults are observed to offset formations as recently as the late Miocene epoch in the Rogue Valley area. However, no Quaternary fault activity has been established for the immediate project area within the Rogue Valley (USGS, Quaternary Fault and Fold Database for the United States 2018).

6.2 SITE GEOLOGY

The project area is located in the Medford East, Oregon 7.5-minute USGS topographic quadrangles. Mapped geologic units at the project area consist primarily of Quaternary Surficial Deposit units formed from alluvial deposits and consisting of mixed grain sediments over sedimentary bedrocks of the Payne Cliff Formation (OGDC-6 2015) and mafic volcanic bedrocks. Based on our geotechnical explorations at the project site, alluvial deposits of sandy Silt and Clay extended to between 2.5 and 11.5 feet before encountering Sandstone or the mafic volcanic bedrock units.

6.3 TECTONIC SETTING

The project site is in regional proximity to several zones of active seismicity. The region is affected by the Cascadia Subduction Zone, an active subduction zone off the Oregon coast considered capable of Magnitude 8.5 or greater earthquakes. This zone is approximately 110 miles from the project site. Average recurrence intervals for such great earthquakes, as determined by recent investigations, range between 300-600 years. The last "great" earthquake was interpreted to be approximately 320 years ago.

Relatively deep focus intraplate (depths of 40-60 km within the subducted Juan de Fuca plate) earthquakes of Magnitude 7.0 are considered possible within the subducted plate beneath western Oregon and Washington. The recurrence interval is not established, but the devastating earthquakes in Puget Sound (M7.1, 1949; M6.5, 1965; and M6.8, 2001) are assumed to have occurred in this seismic zone. Based on the historic seismic record, intraplate earthquakes are considered rare in Oregon.

Relatively shallow crustal earthquakes up to Magnitude 6.5 can occur in the upper plate at depths of 5-25 km. This is the zone which generally produces most of the earthquakes in Western Oregon, and in the project region. Such earthquakes occur once every one to two decades, and historically have not exceeded M 4.5 within a 50 miles radius of the project area (excluding the 1993 Klamath Falls earthquake discussed below).

The project area has an additional tectonic source from earthquakes occurring along Basin and Range faults as close as ~40 miles to the east. This region has produced numerous earthquakes, including significant events near Klamath Falls and Warner Valley. Such events occur generally once every one to two decades.

6.4 HISTORIC SEISMICITY OF AREA

Three of the four largest seismic events in Oregon's recorded history have occurred near southwestern Oregon (data from the Milton-Freewater event of July, 1936 has been reevaluated and upgraded from M5.8 to M6.1, making this Oregon's second largest recorded event).

The 1873 Port Orford, considered Oregon's largest earthquake, is estimated between M 6.3 and M 6.7. Some researchers place this event east-southeast of Brookings near the Oregon/California border, and refer to it as the Crescent City earthquake. Chimneys were toppled in Grants Pass and Jacksonville during this event, indicating Modified Mercalli Intensities of VI and VII in the Rogue Valley area. The quake was felt as far north as Portland, and in San Francisco to the south. This event had an epicenter distance of approximately 70 miles from the project area.

Most recently, the September 20, 1993 Klamath Falls quakes (M5.9 and M6.0) are the third and fourth largest events reported in Oregon. Mercalli Intensities of VII were experienced in the Klamath Falls area; effects of this earthquake were felt in Medford as Mercalli Intensity V. In the Grants Pass and Roseburg areas Mercalli Intensities of IV and V were reported. The focus of the M6 event is immediately east of Lake of the Woods, on a fault system extending from the Basin and Range province. The quake had a focal depth of 12 km, and epicenter distance from the project site of approximately 38 miles.

6.5 GEOLOGIC HAZARDS REVIEW

Flood. The project is not within any designated FEMA Special Flood Hazard Area ("100-year" flood), as shown on online mapping (OregonRiskMap, 2018). Risk of flood damage to the project site is considered to be very low.

Landslides / **Slope Instability.** The project site is relatively flat. There are no slopes at or adjacent to the site that may impact the site due to instability. Therefore, damage to the site due to slope instability is considered low.

Expansive Soils. Soils encountered at the site during the subsurface investigations are clayey to depths of 11.5 feet. Atterberg Limits testing results on three clayey soil samples indicated that the two shallow samples (up to 5 feet) consisted of expansive clay and the deeper sample (9.0'-10.1') resulted as lean clayey silt. Expansive index testing of two shallow silty/sandy clay samples resulted in EI₅₀ values of 57 and 91, which are considered to have medium to high expansion potential.

Recommendations for preparation of the foundation and slab-on-grade subgrades are provided in the geotechnical recommendations section of the report and must be followed in order to mitigate potential expansive soil issues for the project.

Liquefaction. Soils tested were all cohesive with only small pockets of lean silts immediately above the sandstone in the middle and northern portion of the site. These

materials are not known to liquefy in a seismic event at the densities observed. Also, when mitigated as recommended within this report, the risk of liquefaction at the project site considered to be very low.

Ground Rupture. No active fault traces or local faults are mapped within the project site (USGS; 2021). The risk of surface rupture is considered to be very low at the project.

Ground Shaking. Project structures including foundations and retaining walls must be designed for the potential for very strong ground shaking during the anticipated seismic event. The peak site modified horizontal acceleration (PGA_M), is 0.351g (see *Section 6.6*, below). This is based on the Site Class C designation, determined for the project from the subsurface exploration and laboratory testing. The PGA_M value can be used with an appropriate coefficient to determine the seismic coefficients used in pseudo static analysis for design of the structures.

Seismic Ground Amplification or Resonance. No unusually hazardous amplification or resonance effects on seismic waves have been associated with the soil/bedrock subsurface conditions in the project area. The site modified peak horizontal acceleration (PGA_M), is 0.351g. This is based on the Site Class C designation, determined for the project from subsurface explorations, office studies and laboratory testing data.

Tsunami/Seiche Hazard. The project is located approximately 80 miles inland and is not subject to tsunami hazard. The project site is not located adjacent to any large lakes or bodies of water. Therefore, no seismically induced seiche hazard exists for the project. No large reservoirs are located in a drainage area upslope from the project site. Therefore, the project site is not subject to hazard from seismically induced reservoir failure.

6.6 2019 OSSC AND 2016 ASCE DESIGN EARTHQUAKE

6.6.1 Site Class

The proposed structures will be supported on the very dense soils and weathered bedrock encountered at a relatively shallow depth. Therefore, a Site Class of C should be used for the project.

6.6.2 Seismic Design Parameters

The design earthquake for the project area is based upon established values and methodology in ASCE 07-16 as recommended by the Oregon Structural Specialty Code (OSSC 2019). The Maximum Considered Earthquake (MCE_R) and spectral response accelerations were established as set forth in Chapters 11 of ASCE 7-16 and were obtained partly from the online ATC Hazard by Location tool. Table 1, on the following page, provides the design acceleration parameters recommended to be used for design of the project area identified as site class C.

3200 Crater Lake Avenue (02-6139-01)			
Project Area: Medford, Oregon	Longitude: -122.85470		
Risk Category			
Mapped Spectral Response Acceleration, MCER			
Short Period SS , 0.2s (from Figure 22-1) ASCE 7-16	62.0% of g =	0.620 g	
MCEr 1 sec Period S1 , (from Figure 22-2) ASCE 7-16	35.7% of g =	0.357 g	
Site Class	(2	
Site Coefficients Fa , Short Period (Table 11.4-1 ASCE 7-16)	1.252		
Site Coefficients Fv, 1 sec Period (Table 11.4-2 ASCE 7-16)	1.500		
Spectral Response Acceleration, SMS , Short Period (Fa*Ss equation 11.4-1 ASCE 7-16)	0.776	g	
Spectral Response Acceleration, SM1 , 1 sec Period (Fv*Ss equation 11.4-1 ASCE 7-16)	0.535	g	
Design Spectral Acceleration SDS , Short Period ((2/3)*Sмs equation 11.4-3 ASCE 7-16)	0.518	g	
Design Spectral Acceleration SD1 , 1 sec Period ((2/3)*Sм1 equation 11.4-3 ASCE 7-16)	0.357	g	
MCE _G , PGA (Figure 22-9 ASCE 7-16)	29.3% of g =	0.293 g	
Site coefficient, FPGA (Table 11.8-1 ASCE 7-16)	1.2	00	
MCEG adjusted for site class effects, PGA м (FPGA*PGA equation 11.8-1 ASCE 7-16)	0.351	g	
Seismic Design Category SDC (Table 11.6-1 and	0.5<=Sbs = D		
11.6-2 ASCE 7-16)	SD1>0.	2 = D	
Per the requirements of Section 11.6 of the ASCE 7-16 code, the more severe seismic category is assigned which is CATEGORY D			

Table 1 – DESIGN EARTHQUAKE (ASCE 7-16), Site Class C

7.0 CONCLUSIONS

The primary geotechnical considerations for this site are the surficial expansive soils and the variable thicknesses of the surficial fill and soils layers and depths to the underlying weathered bedrock units.

The clayey soils encountered at the site are expansive and could result in shrink/swell related foundation movement if not properly mitigated. Also, the Clay and Sand soil layers are also compressible and may experience large settlements when heavy loads from the parking garage are imposed. Contrastingly, the shallow, weathered to fresh Sandstone in the south portion of the lot will have little to no settlement under the parking garage. The differing support conditions may result in excessive differential settlement if not mitigated. Recommendations for footing subgrade preparation are provided later in this report to mitigate the expansive soils and differential settlement related problems.

Therefore, in our professional opinion, based on our field investigation and office review, the soil conditions at the site are suitable for the proposed development, provided the recommendations of our report are incorporated in the design and construction of the project.

8.0 GEOTECHNICAL RECOMMENDATIONS

The subject site contains relatively poor surficial soils (highly expansive) support but very good underlying weathered rock for support of the structures. The following sections provide methods for proper site preparation/grading, foundation support and related items for design and construction of the project.

8.1 SITE PREPARATION AND GRADING

Nearly the entire site contains various layers of undocumented manmade fill, including remnants of previous demolition (concrete and other debris). Normal methods of debris removal, clearing, grubbing, stripping for organic and fill removal and subgrade soil preparation will apply.

8.1.1 Manmade Fill & Debris Considerations

The site appears to have various layers of sand and gravel soils and crushed rock fill as well as construction debris, such as large pieces of concrete (some of which has been removed and stockpiled on the site), plastic, brick and wood. The north portion of the project area is covered with a shallow (0.5 to 1.0 feet) area of a clean, 4-inch crushed rock over soil fill with deleterious materials. The southern portion of the site contains up to 4 feet of various sandy fills covered by shallow topsoil and/or ³/₄-inch minus crushed rock with scattered grass. All organic and manmade fill material and debris shall be completely removed from beneath the proposed areas of development. Debris left from demolition, including old slabs and any old footings or utility lines/canals must be removed from under all site areas proposed for development. The existing onsite undocumented rock fill that is reasonably clear of organics and debris may be reused (after review and approval) on the site as specified later in this report. All other debris or debris laden soil must be wasted off site. The full extent of any waste fill removal will be determined during site stripping operations.

8.1.2 Clearing, Grubbing and Stripping

All areas proposed for structures, access roads, parking areas and sidewalks and structural fill beneath these items shall have all debris (including organics) removed and be cleared and grubbed of all trees, stumps, brush and other debris and/or deleterious materials. The site shall then be stripped and cleared of all vegetation, sod and organic topsoil. It appears that a stripping depth from 2 to 6 inches will be required. Additional stripping (or excavations) will most likely be required to remove pockets of organics and any waste fill areas encountered. The stripped materials and loose fill soils removed shall be hauled from the site or stockpiled for use in landscape areas only (such as landscape mounds). This material shall <u>not</u> be used in structural fill or trench backfill.

If encountered, abandoned utility lines, storm drains, underground tanks or other items which provide void space beneath the surface must be removed or effectively plugged. Movement of surface and/or groundwater through these old conduits can create the potential for piping of soils (the removal of soil fines by water seeping into the void spaces or through conduits), resulting in subsidence of the surface or settlement of structures and paved areas.

Holes or depressions resulting from the removal of underground obstructions or excavations for old foundations and the test pits that extend below the finish subgrade and will be beneath structures, walkways, parking or roadways shall be cleared of all loose material and dished to provide access for compaction equipment. These areas shall then be backfilled and compacted to grade with structural fill, as described later in this report.

It is recommended that grubbing and stripping of the site, old fill removal, decision for reuse of old granular fill and backfill and compaction of depressions below finish subgrade, be observed and/or decided by the geotechnical engineer or his representative from The Galli Group.

8.1.3 Dewatering

Saturated soils/seepage zones were encountered within the surficial soil layers above the weathered rock at between 3.0 and 5.5 feet below the ground surface along the north end of the site during our subsurface investigation. This condition is likely caused by the Hopkins Water Canal, which extends through this area of the site. However, saturated conditions and/or perched groundwater levels across the site may rise closer to the surface in the wet winter months.

Dewatering can likely be achieved by installing a series of cut off trenches or French drains around the site and existing/proposed structure locations. This way, groundwater can be intercepted by these drains and rerouted to a sump where it can be pumped to an approved discharge location. Alternately, when the site is excavated, water <u>may</u> be able to be removed by a series of sumps around the perimeter and throughout interior portions of the excavations. The contractor is responsible for removing water from excavations and providing a stable subgrade prior to construction.

8.1.4 Subgrade Redensification

After removal of all vegetation, organic soil and deleterious materials and when the subgrade has been cut to grade, it must have the surface layer redensified. This can be accomplished by at least two passes with a large vibratory roller. Care must be taken to not over-vibrate and disturb the subgrade soils during wet weather. This densification shall be accomplished on all subgrade areas of the site beneath the foundations, slabs and asphalt areas.

8.1.5 Subgrade Proofrolling

The exposed subgrade throughout the site which will support structures, roadways, exterior slabs, fills, parking and sidewalks shall be proofrolled (after grubbing and stripping, and over-excavation and dewatering, where required) under the observation of a representative from The Galli Group. The proofrolling may be accomplished with a loaded dump truck, loaded water truck or large heavy roller (no vibration). Proofrolling shall be discontinued if it appears the operation is pumping moisture up to the surface or otherwise disturbing the in-place soils. When proofrolling, the tires of a loaded truck shall not deflect the soils more than ³/₈ inch.

Where subgrade soils are disturbed or do not demonstrate a firm, unyielding condition when proofrolled, the soil shall be redensified or aerated and redensified, or replaced with imported granular fill. The imported fill material shall be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM Test Method D-698 (Standard Proctor). All soft and/or unstable areas shall be over-excavated and backfilled with granular structural fill.

Note: This proofrolling and subgrade verification shall be accomplished on all exposed native soil subgrades and over-excavated areas as well as on all layers of placed and compacted structural fill and finish subgrade surfaces.

CAUTION

Where site subgrades consist of clayey Silt to silty Clay soils the surface must be kept in a moist and fully swelled condition until structural fill, AC or concrete is placed. This will minimize shrinkage of any expansive soils within the unit and prevent formation of shrinkage cracks. Possible methods for protecting the exposed Clay soils include sprinkling, periodic sprinkling with a water truck, covering with plastic sheeting, or delaying stripping until immediately before placing backfill materials. If dry clay soils are covered and not rewetted, swell related problems will likely develop.

We recommend our firm observe proofrolling of the excavated subgrade after excavations are complete and prior to placement of structural fill. After completion of site stripping and/or excavation to subgrade, the contractor shall take care to protect the subgrade from disturbance due to construction equipment, especially during very wet weather.

8.2 UTILITY AND SITE EXCAVATIONS

During the construction of the project, cuts and fills in excess of 4 feet could be required for this site. These must be constructed at proper inclinations and be of the recommended materials to remain stable. Also, utility excavations will be required for construction and installation of utility lines and facilities within the project site. The utility excavations will likely encounter the Clay and clayey Sand soils and/or weathered Sandstone.

Excavations. Excavators of all sizes will be able to remove the overlying clayey soils. Only medium to large excavators equipped with good teeth will be able to remove the weathered rock. Deeper excavations into the shallow Sandstone on the southern portion of the site will likely require large equipment and possibly rock hammers to excavate.

Trench excavations during dry weather should stand in shallow trenches in soils (less than 4 feet). However, these are likely to have some sloughing off the walls. Seepage or wet weather and long-term dry weather can cause the upper soils to slough into the trench. Trench excavations deeper than 4 feet in the clayey soils may require the use of temporary shoring, trench boxes and/or temporary cut slopes to protect workmen. See *Section 8.3.2*, below, for more information. Trenches cut into the sandstone will likely stand for longer periods of time during dry weather.

8.2.1 Temporary Cut Slopes

During dry weather, temporary cut slopes up to 5' in height may be cut at 1H:1V or flatter. During wet weather, or for deeper excavations, the contractor must be prepared to flatten temporary cut slopes in the clayey, sandy and gravelly soils to 2H:1V or flatter. Temporary cut slopes in the weathered rock may be cut at 1H:1V in all weather.

Please note, that while we have commented on the anticipated stability of the soil in trenches and cuts, we are not responsible for job site safety. The contractor is at all times responsible for job site safety, including excavation safety. We recommend all local, state and federal safety regulations be adhered to.

8.3 STRUCTURAL FILL PLACEMENT AND COMPACTION

8.3.1 Beneath Structures and Roadways

Structural fill is defined as any fill placed and compacted to specified densities and used in areas that will be under structures, driveways, sidewalks and other load-bearing areas or that will create fill slopes. It appears that the portions of the project containing the building pad, parking areas, exterior slabs and sidewalks will have structural fill below them. The subgrade needs to be prepared properly (see *Section 8.1*) and the fill must be placed and compacted correctly for proper long-term performance.

Structural Fill Materials. Ideally, and particularly for wet weather construction, structural fill shall consist of a free-draining granular material (non-expansive) with a maximum particle size of six inches. The material shall be reasonably well-graded with

less than 5 percent fines (silt and clay size passing the No. 200 mesh sieve). During dry weather, any organic-free, non-expansive, compactable <u>granular</u> material, meeting the maximum size criteria, is typically acceptable for this purpose. Locally available crushed rock and <u>clean</u>, jaw-run crushed "shale" (low-grade rock) have performed adequately for most applications of structural fill. See *Section 9.0* for Structural Fill Specifications. The on-site silty Clay soils shall <u>not</u> be used as structural fill beneath structures. However, the on-site underlying, dense Sands (pulverized Sandstone) and portions of the on-site undocumented rock fill, which are clear of organics and debris, may be utilized as structural fill for certain limited applications, pending on-site review and approval by the geotechnical engineer or his representative, prior to use (see the following sections of this report for requirements regarding specific structural fill materials and uses).

Note: Section 9.0 provides various options for Structural Fill. Some will be difficult to nearly impossible to compact during wet weather. The contractor <u>must</u> select the type of structural fill that will be able to be placed and compacted during the weather conditions that can take place during the expected construction schedule.

Structural Fill Placement. All structural fill shall be placed in horizontal lifts not exceeding 8 inches loose thickness (less, if necessary to obtain proper compaction) for heavy compaction equipment and four inches for light and hand-operated equipment. Each lift shall be compacted to a minimum of 95 percent of the maximum dry density, as determined by ASTM Test Method D-698 (Standard Proctor) unless noted otherwise for specific uses and/or material types.

Beneath Footings. Structural fill placed beneath footings or other structural elements must extend beyond all sides of such elements a distance equal to <u>at least the total depth</u> <u>of the structural fill</u> beneath the structural element in question for vertical support (i.e., for 2 feet of structural fill beneath footings, extend the fill at least 2 feet past <u>all edges</u> of the footings).

To facilitate the earthwork and compaction process, the earthwork contractor shall place and compact fill materials at or slightly above their optimum moisture content. If fill soils are too high on the wet side of optimum, they can be dried by continuous windrowing and aeration or by intermixing lime or Portland Cement to absorb excess moisture and improve soil properties. If soils become dry during the summer months, a water truck shall be available to help keep the moisture content at or near optimum during compaction operations.

Fill Placement Observation and Testing Methods. The required construction monitoring of the structural fill utilizing standard nuclear density gauge testing and standard laboratory compaction curves (ASTM D-698 specified) is applicable to materials 2-inch size and smaller. Larger (2¹/₂" or above) jaw-run "shale" and crushed rock cobbles and gravels do not yield consistent results with this type of testing. The high percentage of rock particles greater than ³/₄'s of an inch in these materials causes laboratory and field density test results to be erratic and does not provide an adequate representation of the density achieved. Therefore, construction specifications for this

type of material typically specify method of placement and compaction coupled with visual observation during the placement and compaction operations and proofrolling of lifts, instead of nuclear density testing.

Observation of Fill Placement. For these larger rock materials, we recommend the 8inch lift (after being "worked in" with a dozer) be compacted by a minimum of 3 passes with a heavy vibratory roller. One "pass" is defined as the roller moving across an area once in both directions. The placement and compaction should be observed by our representative. After compaction, as specified above, is completed the entire area shall be proofrolled with a loaded dump truck to verify density has been achieved. All areas which exhibit movement or compression of the rock material more than 1/4 inch, under proofrolling, shall be reworked or removed and replaced as specified above.

Nuclear Density Testing of Fill. Field density testing by nuclear density gage will be adequate for verifying compaction of 2-inch to ³/₄-inch minus crushed base rock, clay and silt soils, sands and other materials 2 inches or smaller in size. Therefore, typical % compaction specifications will suffice. Testing shall be accomplished in a systematic manner on all lifts as they are placed. Testing only the upper lifts is not adequate.

8.3.2 Non-Structural Fill

Any waste soil, organic strippings or other deleterious soil will be considered nonstructural fill. These materials may make reasonable landscape soils and lawn topsoil material. This material may be placed in landscape areas and waste soil areas such as berms with slopes at 3.5H:1.V or flatter. It shall not be placed under structures, sidewalks, roadways, parking areas or as part of a structural fill slope. It is recommended that when these soils are used, they be given a moderate level of compaction (90 to 92 percent) to help seal them from surface water.

8.4 UTILITY LINE RECOMMENDATIONS

Below we have provided general recommendations for utility construction for the project. Recommendations are based upon observations from our field investigation and experience on other projects with similar subsurface conditions.

CAUTION

Trench Excavation. Trenches will be required across the site for utility installation of various kinds. As discussed earlier, all <u>soils</u> encountered should be able to be excavated with most excavators, with the exception of the Sandstone (bedrock) in the south portion of the lot. Trench excavation should be moderately easy in most areas of the site. *Sideslopes of trenches deeper than 48 inches will likely ravel and collapse due to gravels and cobbles in the clay materials.* Therefore, trench boxes or wide trenches will likely be required for deeper trenches. *Do not accomplish vertical excavations to within 1-foot of groundwater levels; sidewall failures and even full sidewall collapse will likely take place.*

Trench Backfill and Compaction. The new utility lines will require trench backfill and compaction along the entire alignment. The pipes need to be adequately supported and the trenches need to be backfilled and compacted properly to prevent potential subsidence of the surface or damage to utility lines or overlying structure foundations or pavement sections.

In our experience, utility trench backfill has been the source of the majority of postconstruction fill settlement problems in paved areas. They are also areas which cause early pavement failure due to inadequate subgrade support.

Pipe Bedding. The bottom of the trench must be shaped out of acceptable bedding materials (refer to manufacturer's recommendations) to fit the pipe base prior to placement of the pipe. It is critical to the long-term performance of the pipe that the bottom and haunches be fully supported by a dense bedding which decreases pipe distortion from load. Finer crushed rock materials (such as ³/₄-inch minus crushed rock) usually provide the best bedding material.

Pipe bedding shall be compacted to 95% of ASTM D-698 (Standard Proctor) or to that which is specified by the pipeline designer. Cement-treated pea-gravel or sand/cement slurry (with at least 200 pounds of cement per cubic yard) will solidify and will typically not require compaction after placement and also makes good bedding material. Care must be taken to make sure the pipe does not "float" up in the fluid mix prior to it "setting".

Pipe Zone Material. All of the lines shall be backfilled around and to approximately 12-inches (more, if required by manufacturer) above the pipe with an acceptable "pipe zone" material. This may consist of finer crushed rock, cement-treated pea gravel, sand/cement slurry, coarse sand with fine gravel, or other material acceptable to the client and pipeline designers. The pipe zone material shall be well compacted <u>on each side of the pipe</u>, and to at least 12 inches above the pipe. <u>Mechanical means will typically be required to densify these materials to the required densities</u> (unless a cement-treated material is used). <u>Water settling is not allowed</u>.

Density requirements for "pipe zone" backfill shall be per the manufacturer's specifications for the type of pipe being used (we recommend using 95% to 97% of ASTM D-698). Care shall be taken when compacting adjacent to and immediately above the pipe so as to not damage the pipe.

General Trench Backfill. Above the "pipe zone" the backfill materials will typically consist of any compactable material that does not have excessive voids (such as gap-graded large gravels and cobbles), organics, expansive clay, debris or other deleterious material. Crushed rock, clean jaw-run shale and sand and gravel work well for general trench backfill.

Where laterals of any kind, or valving, extend upward from the lines, we recommend the trench areas adjacent to these items be backfilled with the "pipe zone" backfill materials.

This will prevent the larger pieces of other backfill materials from damaging the valves and/or other equipment.

We strongly recommend that all general trench backfill be placed and compacted in the same manner as for general structural fill. Trench backfill beneath asphalt pavements and under the administrative structure shall be compacted to at least 95 percent of the maximum dry density, as determined by ASTM Test Method D-698 (Standard Proctor). Trench backfill in landscape areas, that are not part of a cut or fill slope, may be compacted to at least 93 percent of the maximum dry density.

8.5 BUILDING SUPPORT RECOMMENDATIONS

During our site investigation we encountered medium stiff to stiff, moderately to highly expansive clays to a depth of up to 7.0 feet in the north and east portions of the site. In southern portions of the site, the Sandstone bedrock was encountered directly beneath the undocumented fill materials at depths as shallow as 1.75 feet.

We anticipate that the proposed Administrative Building, to be located on the north end of the site, will encounter the expansive Clay soils at foundation subgrade levels. The proposed Parking Garage will likely encounter the shallow sandstone beneath much of the middle and southern half of the structure's foundations but then will transition to the softer clay soils beneath the northeast corner of the structure.

Mitigation of the potential shrink/swell related foundation movements must be accomplished for structures located on expansive Clay subgrades. Ideally, removal of <u>all</u> the expansive clay down to non-expansive soils or rock units would be accomplished to provide foundation support for the proposed structures. However, since the depths of the expansive Clay soils are expected to be at least 7 feet in some areas of this site, removing the entire unit of expansive clay and replacing it with structural fill to bring the excavated area back up to grade is not always necessary and can be cost prohibitive. As an adequate mitigation alternative for protecting structures from potentially adverse impacts of the moderately to highly expansive clay soils, where encountered, the proposed structures' footings may be supported on at least 24 inches of crushed rock structural fill (4" minus to $\frac{3}{4}$ " minus crushed rock) for footing and slab support, founded at least $3\frac{1}{2}$ feet below finish exterior grades and at least 2 feet below interior crawlspace grades.

This approach will require importing fill and construction monitoring of fill compaction. This method of support involves a small risk of possible future building differential movements due to the possible shrink/swell of the expansive clays being left in place under the footings. However, numerous projects with similarly highly expansive clays have used this method of foundation support without significant differential settlements. In our professional opinion, design and construction of the proposed Administration Building utilizing this *Footing Support On Expansive Clays* method of support will provide adequate expansive soil mitigation and support for the structure. Recommendations for this support method are provided in *Section 8.5.1*.

For the Parking Garage, we recommend that all of the surficial soils be removed down to the underlying bedrock, and the proposed structures' footings be supported on at least 6 inches (or more, if needed) of crushed rock structural fill, in order to provide uniform support for the structure. This is due to the excessively high differential settlement that is likely to occur under the heavy loading of the structure as a result of the shallow, hard sandstone subgrade beneath the south half of the structure and the softer, expansive silty Clay, clayey Sand and clayey Gravel soils subgrade beneath the north and east ends of the structure. Also, since finished floor elevation of the lower garage level of the structure will be partially embedded below existing grades and the structure will have large footings that extend below the slab section, we anticipate that the additional over-excavations needed to remove all the surficial soils down to the weathered bedrock will likely be limited to a small portion of the overall footprint of the structure and over-excavation depths will be limited to 2 to 4 feet or less. Recommendations for *Footing Support on Weathered Bedrock* are provided in *Section 8.5.2*.

8.5.1 Footing Support On Expansive Clays

We recommend the following for footings supported on at least 24 inches of structural fill (crushed rock, shale or decomposed granite) at the bottom of an area over-excavated at least 3½ feet below finish exterior grades (2½ feet below interior crawlspace grades) into the native Clayey subgrade soils. We recommend this method of support for the Administrative Building. This recommendation is necessary if it is determined that portions of the structure's foundation support will encounter the expansive soils after initial site grading.

- 1. Footing areas designated to receive structural fill should first be excavated to a depth of at least 3½ feet below finish exterior grades. The subgrade should be free of disturbed and loose soil prior to placing fabric and structural fill (redensify/prepare the subgrade soils as described in *Sections 8.1.4* and *8.1.5* of this report). Any clay subgrade soils left in place must be kept wet and fully swelled prior to covering with fabric and structural fill.
- 2. The width of the crushed rock structural fill placed beneath footings must extend laterally beyond the outside edges of all footings a distance equal to <u>at least</u> the total depth of the structural fill for vertical support (i.e., for 2 feet of structural fill beneath footings, extend the fill at least 2 feet past all edges of the footings) and be constrained laterally on all sides.
- 3. Cover the base of the footing excavations with a woven geotextile support fabric (ACF 180, ACF S200 or equivalent).
- 4. Place and compact a minimum of 24" of crushed rock structural fill over the support fabric. Top of the crushed rock structural fill must extend up to the elevation of the bottom of footing. For ease of use, the top 6 inches of structural fill may consist of ³/₄" minus crushed rock. Compact this crushed rock structural fill in 6" to 8" lifts to at least 98% of ASTM D-698.
- 5. Footings shall be buried a minimum of 12 inches below finish grade in order to provide lateral support and frost protection. Footings should be backfilled against with non-expansive fill.

- 6. Footings placed on the redensified subgrade, covered with compacted crushed rock as listed above, may be designed for an allowable bearing pressure of 1,500 pounds per square foot. A 1/3 increase in this allowable bearing pressure may be used when considering short-term transitory wind and seismic loads.
- 7. We recommend minimum lateral dimensions of 16 inches for continuous load bearing footings and 36 inches for isolated piers constructed in this manner. We recommend all footings and any slab on grade areas of the structure be tied together structurally.

Two alternatives could be used to remove the expansive clay beneath all footings and to replace it with compacted structural fill. The first would be to excavate a trench (approximately four to five feet wide) beneath all footings to a depth of $3\frac{1}{2}$ feet below finish exterior grade and excavate to $2\frac{1}{2}$ feet below interior crawl space grades. The trenches would then be backfilled with compacted crushed rock or shale up to finish subgrade for the footings. However, there could be numerous strip footings across the house necessitating a number of trenches which can cause significant access problems when placing and compacting the structural fill.

The second alternative would be to remove the clay soils down to the required depth over the entire footprint of the home and to approximately two or three feet outside the edges of all footings. This would require one large excavation (no trenches needed). The entire area would then be backfilled in lifts with compacted structural fill. This will require at least 24 inches of crushed rock structural fill over the entire footprint. In this way, access would not be a problem and placement and compaction of the structural fill could be accomplished with large equipment. This also provides better support for isolated piers and for the garage slab. We recommend this alternative as the better of these two for long-term foundation support and for the most uniform and stable building pad for the residence.

Anticipated Settlements. For properly constructed foundations on expansive Clay soil subgrades, as described above, we anticipate maximum total and differential settlements to be less than 3/4-inch and 3/8-inch, respectively.

Foundation Drains. We typically recommend all footings be installed with a footing drain to intercept groundwater seepage. Footing drains shall consist of a rigid, smooth-wall perforated pipe surrounded by drain rock (sides and above), all wrapped in a non-woven geotextile fabric and shall be placed adjacent to the footings. See *Figure 4* for details. This is addressed more fully later in this report (*Section 8.10*).

8.5.2 Footing Support on Weathered Bedrock

We recommend the following for footings supported on at least 6 inches of crushed rock structural fill over Weathered Bedrock subgrade (after removal of all the surficial silty Clay, clayey Sand and clayey Gravel soils). We recommend this method of support for the Parking Garage. Footings shall be constructed and designed based on the following recommendations.

- 1. Excavate into the weathered rock for footing subgrade, removing all expansive soils from below the bottom of the footings. Over-excavate to at least 6 inches below the bottoms of all footings
- 2. Redensify the footing subgrade at any locations disturbed during excavation using a hoepack attachment on a medium size or larger backhoe.
- Place and compact a minimum of 6" of ³/₄" minus crushed rock structural fill for uniform building support (more, if required to build up to footing/slab subgrade levels). Compact this crushed rock structural fill in 6" to 8" lifts to at least 98% of ASTM D-698. The top of the crushed rock should be at the elevation of the bottom of footing.
- 4. Footings placed on the weathered bedrock with at least 6 inches of compacted crushed rock subgrade, as listed above, may be designed for an allowable bearing pressure of 3,000 pounds per square foot. A 1/3 increase in this allowable bearing pressure may be used when considering short-term transitory wind and seismic loads.
- 5. The base of the footings shall be embedded a minimum of 12 inches below finish grade in order to provide lateral support and frost protection.
- 6. We recommend minimum lateral dimensions of 18 inches for continuous load bearing footings and 36 inches for isolated piers constructed in this manner. **Note:** Grade beam foundation walls that connect large spread footings and are lightly loaded may be 10" to 12" wide.

Anticipated Settlements. For properly constructed foundations on Weathered Bedrock, as described above, we anticipate maximum total and differential settlements to be less than 3/4-inch and 3/8-inch, respectively.

8.6 INTERIOR FLOOR SLABS

It is generally best to remove all expansive clay soils from beneath floor slab areas. Alternately, in any areas where the expansive soils are left in place beneath the floor slabs, we recommend a compacted structural fill layer at least 24 inches thick to provide support and to minimize the shrink/swell potential of the expansive subgrade soils. A properly prepared building slab area, consisting of at least 6-inches of crushed rock over either a 24" thick structural fill pad (on native Clay soils subgrades) or a properly prepared Weathered Bedrock subgrade, will provide good support for concrete slab-ongrade floors.

Standard Slab Section. The following recommendations are provided for slabs constructed on the densified subgrade.

- 1. For slab-on-grade floor areas over native clay subgrades, construct the 24" thick structural fill pad, as described in *Section 8.5.1*. Or, for weathered Sandstone/Siltstone subgrades, redensify exposed subgrade area.
- Backfill up to the bottom-of-slab elevation with a minimum of 6 inches of compacted 3/4 inch minus crushed rock structural fill. Densify the structural fill to at least 95% per ASTM D-698. Note: If site grades indicate surface water

may infiltrate into the rock below the slab; the top 6" of the crushed rock shall be <u>clean</u> 1/4" to 3/4" crushed drain rock, if there is concern with moisture causing problems for the slab floor.

3. A tough impermeable membrane, such as Stego Industries 15-mil vapor barrier (or an equivalent product) shall be placed over the crushed rock layer to further retard upward migration of moisture vapor into and through the concrete slab. Seal all seams, punctures, penetrations and tears with manufacturer's recommended method.

Note: If it appears water may pond in the rock below the slab, a series of slab subdrains should be installed. These shall be constructed as shown on *Figure 5* and as described later in report *Section 8.10*.

8.7 MODULUS OF SUBGRADE REACTION

8.7.1 Static Subgrade Modulus

We have estimated the modulus of subgrade reaction (k) of the subgrade soils encountered during our site investigation. We estimated the k_1 for the medium stiff to very stiff silty Clay to be 91 pci (pounds per cubic inch). We estimated the k_1 for the hard Sandstone to be 500 pci (pounds per cubic inch). The estimated k_1 refers to the reaction for a 1ft x 1ft foundation bearing on the prepared subgrade. For design purposes, project designers must adjust the k for the size of footing or slab using the following correlation from Terzaghi, 1955, or other acceptable correlation.

$$k_l = k_1 \left(\frac{l+0.5}{1.5l}\right)$$

Where k_l = Modulus of subgrade reaction for given footing length L and width B

l = Ratio of footing length L to width B

 k_1 = Modulus of subgrade reaction for 1ft plate (estimated)

Note: *l* is equal to 1.0 for square footings.

8.8 LATERAL LOAD RESISTANCE

Lateral loads exerted upon these structures can be resisted by passive pressure acting on buried portions of the foundations, retaining walls and other buried structures and by friction between the bottom of structural elements of the foundations and slabs and the underlying soil.

We recommend the use of passive equivalent fluid pressures of the following values for portions of the structure and foundations embedded into the native soils.

•	Native Silt and Clay	200 pcf; FS=1.0
•	Dense Compacted Crushed Rock (5' wide minimum)	450 pcf; FS=1.0
•	Medium Hard Sandstone Bedrock	400 pcf; FS=1.0

A coefficient of friction of 0.55 can be used for elements poured neat against crushed rock structural fill. These can be reduced to 0.20 for areas over a vapor barrier or 0.30 over native Silt and Clay soils.

8.9 RETAINING WALLS

Lateral earth pressures will be imposed on all below ground and backfilled structures or walls, including foundations which do not have uniform heights of fill on both sides and grade separation retaining walls. The following recommendations are provided for design and construction of conventional reinforced concrete or CMU block retaining walls as well as for mechanically stabilized earth (MSE) walls:

• We recommend walls which are free to rotate at the top (unrestrained) when backfilled, be designed for the following loads.

Low Grade Angular Rock/Shale EFP	40 pcf
Crushed Rock EFP	35 pcf
Seismic coefficient (up to 10 feet tall)	0.17g

• Walls that are fixed at the top (restrained) when backfilled should be designed for the following loads.

Low Grade Angular Rock/Shale EFP	50 pcf
Crushed Rock EFP	45 pcf
Seismic (up to 10 feet tall)	0.35g

- The walls <u>all</u> must have full drainage as described in *Section 8.10* and as shown on *Figure 6*.
- The above listed loads/equivalent fluid pressures are to be used for the soil through which the anticipated failure plane will develop (assume envelope beginning 4 feet behind base of wall and rising up and away from wall at 60 degrees off the horizon).
- A wet soil unit weight of 140 pcf should be used for design of retaining walls which are backfilled with crushed rock or jaw-run "shale".
- These values are for properly compacted, free draining walls. The onsite Expansive Clay soils/rock shall not be used for wall backfill. Imported crushed rock or clean jaw-run "shale" work well for wall backfill materials.
- These design values assume the wall or structure is fully drained, has a flat backfill and has no surcharge loads from traffic or other structures. The structural designer should include surcharge loading from traffic, building loads and/or sloped backfill.

- We recommend designing retaining walls to resist seismic loading. A horizontal acceleration coefficient (k_h) of at least 0.35g (for rigid retaining walls that cannot accommodate any lateral displacements) and 0.17 (for retaining wall systems that can accommodate 1-2 inches of lateral displacement) should be applied to the mass of an enlarged active wedge of soil behind the walls and utilized in a pseudo-static analysis. The wedge length back from the wall along the ground surface may be taken to be 0.8H, where H is the height of the wall.
- The backfill should be placed in lifts at near the optimum moisture content (at 2% to 3% above optimum) and compacted to between 93 and 95 percent of the maximum dry density as determined by laboratory procedure ASTM D-698 (Standard Proctor). Loosely placed backfill will exert greater pressures on the wall than the pressures provided above and <u>must</u> be avoided.
- To prevent damage to the wall, backfill and compaction against walls or embedded structures should be accomplished with lighter, hand-operated equipment within a distance of 1/2 h (h being the vertical distance from the level being compacted down to the surface on the opposite side of the wall). Outside this distance, normal compaction equipment may be used.

While proper compaction of wall backfill is critical to the proper performance of the walls, care should be taken to not over-compact the backfill materials. Over-compaction can induce greater lateral loads on the wall or structure than the design pressures given above.

8.10 FOUNDATION, FLOOR AND RETAINING WALL DRAINS

All exterior foundations and embedded structures should have proper drainage.

Footing Drains. Foundation drainage shall consist of a rigid, smooth-wall perforated pipe surrounded by at least 6 inches of drain rock on the top and outside edge, all wrapped in a non-woven geotextile designed as a filter fabric (such as Mirafi 140N or equivalent). The perforated pipe shall be located on the footing next to the stem wall (or beside the footing), provided this is at least 12 inches below underslab drain rock (if applicable). Please see *Figure 4*.

Floor Slab Subdrains. Where the drain rock layer below slabs will be lower than the adjacent exterior grades and there are water bearing zones that can saturate the underslab rock, water will tend to accumulate in this low area. To remove the water, include a series of subdrains at the bottom of the drain rock layer beneath the slab. The subdrain lines typically consist of 3-inch diameter, smooth interior, solid wall, perforated pipe at spacing of 10 feet (or less) across the structure (and around the interior perimeter). The perforated pipe is placed in a deepened zone of the drain layer as shown on *Figure 5*. The pipes are sloped to drain and collected by a tightline which leads to the stormwater disposal system. We recommend we be allowed to review the subdrain system design prior to final plan submittal or construction bidding.

Retaining Wall Drainage. In addition to the footing drainage section (see above), located at the base of the retaining wall footing, all retaining walls should also have a minimum 12-inch-wide drainage zone of drain rock wrapped in non-woven filter fabric immediately behind the wall extending up from the drainage section to within 12 to 18 inches of the surface. A preformed, fabric-wrapped, polymer sheet drain, such as Amerdrain, Linq Drain or Enkamat must be placed against the wall. Exterior wall drains, which will not be sealed on top by asphalt or concrete, should have the upper 12 inches backfilled with compacted onsite silty clay soils to minimize intrusion of surface waters into the wall drain system. Please see *Figure 6*.

<u>Walls that should not pass water vapor</u> (for aesthetics or livable space) <u>must be fully</u> <u>sealed</u> (with a bitumen-based sealer that will not harden or crack) before the sheet drain is attached. Wall seal such as MasterBlend HLM5000 or equivalent, shall be used and applied per the manufacturer's recommendations. Multiple coats are preferred.

All drains should be tightlined and positively sloped to an approved stormwater disposal location into the public right-of-way. **Note:** In no case shall water be collected and/or directed or discharged close to the foundations. Such improper water discharge can cause added water related problems.

We strongly recommend <u>against</u> connecting roof drains or surface area drains to foundation or wall drains unless it is to a common discharge line far away from the structure. All drains must consist of rigid, smooth-wall pipe. The rigid smooth-wall pipe can be cleaned out by means of a "roto-rooter" type system should it become plugged with sediment or fine roots. We recommend cleanouts be placed periodically by the designer to facilitate cleaning and maintenance of the drains.

8.11 EXTERIOR CONCRETE FLATWORK

Concrete exterior flatwork at grade will be subjected to significant shrink-swell cycles, (if poured directly on the clay), due to moisture content changes in the expansive clay subgrade soil. These movements tend to cause cracking and vertical offsets at joints and connections with other structures. <u>More uniform support can be achieved by placing at least 10 to 12 inches of compacted non-expansive structural fill beneath these areas. The on-site undocumented crushed rock fill materials, which are clear of organics and debris, should work well for this purpose. Slabs and walkways reinforced with #3 or #4 deformed reinforcing steel (both ways) will also withstand shrink-swell movements better than unreinforced flatwork. The reinforcing must extend across joints and between dissimilar pours (or use dowels) to decrease vertical offset movements and potential trip hazards. Jointing patterns to provide predetermined crack locations will also generally improve the appearance of the finished flatwork.</u>

As listed before, it is <u>critical</u> that the clay subgrade be kept moist prior to covering with the structural fill and concrete. Dried out clay should be removed or rewetted and moisture conditioned to at least 3% above optimum prior to covering. Watering through the structural fill periodically will also keep the clay fully swelled until the area is covered with concrete.

Note: All details for concrete work should be reviewed by the project structural engineer and/or architect.

8.12 ASPHALTIC CONCRETE PAVEMENTS

It is our understanding that the access entrance, drive lanes and some parking will likely consist of Hot Mix Asphaltic Concrete (HMAC) paved surface. The following sections provide recommendations for asphaltic concrete section design and construction.

8.12.1 Pavement Subgrade & Traffic Loading

Much of the subject site is underlain by 4 to 5 feet (up to over 7 feet) of expansive clay soils. These subgrade soils provide relatively poor support for the asphaltic concrete paving and the highly expansive Clay soils will undergo shrink/swell cycles through the wet and dry seasons. However, the expansive soils can be mitigated by incorporating thick layers of subbase aggregate as part the design sections. The remainder of the site is underlain by non-expansive Weathered Bedrock, which will provide good support for asphaltic concrete paving.

From extensive experience with these types of soil on other projects in this area, an R-value of 5 (native Clay) and an R-value of 40 (Sandstone) was used for design purposes. This assumes subgrades have been properly prepared and redensified and all clay soil subgrades have been moistened/fully swelled, as recommended in *Sections 8.1.1 through 8.1.5*. This also assumes that woven support fabric is placed over the prepared native subgrade soils under all HMAC areas.

The following asphalt sections were designed utilizing a Crushed Rock Equivalent (CRE) method. Sufficient thickness of asphaltic concrete and rock materials are used to provide the computed crushed rock equivalent needed to protect the clay soils and weathered bedrock subgrades and successive rock layers from anticipated traffic loads.

We anticipate the traffic loading to consist of autos, pick-ups, recreational vehicles and occasional trash trucks or fire/emergency vehicles. Future loading may include bus traffic on the main drive lane. Only medium heavy (3 axle or 4 axle) truck traffic is anticipated for these accessways on the site. In our professional opinion, based on anticipated traffic at the site, the following portions of the project shall use the Traffic Indice (TI) as listed. The TI values are based on the anticipated traffic numbers, axle loads from trucks and for a 20-year life.

Project Area	Traffic Index (TI)
Heavy Duty	
Entrance and Access Lanes	7.5
Heavy Vehicle Parking	
Standard Duty	5 5
Parking Drive Lanes	5.5
Light Duty	4.0
Light Vehicle Parking	4.0

The successful performance of pavement structures is a function of subgrade material properties, traffic conditions, drainage conditions, the pavement material properties and design, careful construction, and ongoing maintenance.

8.12.2 Asphaltic Concrete Pavement Design

We have designed the pavement sections using the Traffic Indices (TI) listed above. Based on these TI's and by utilizing R-values of 5 and 40 for clay and weathered bedrock subgrades, respectively, 50 (4" minus crushed rock subbase, or ASB) and 80 (3/4" or 1" minus crushed rock aggregate base, or AB), we have computed asphalt design sections (utilizing the Crushed Rock Equivalent Method) with the following results.

When founded on the **Sandstone**, an R-value of 40 was used for the following designs:

Heavy Duty Pavements (TI = 7.5) – Main Entrance Roads

4" Asphaltic Concrete

6" Aggregate Base (AB - 3/4" or 1" minus Crushed Rock) 12" Aggregate Subbase (ASB - 4" minus Crushed Rock or approved equivalent) Geotextile Support Fabric (ACF 180, S200 or Equivalent) Re-densified hard/dense soils (Sandstone) Subgrade

Standard Duty Pavements (TI = 5.5) – Parking Lot Access

3" Asphaltic Concrete 8" Aggregate Base (AB - 3/4" or 1" minus Crushed Rock) Geotextile Support Fabric (ACF 180, S200 or Equivalent) Re-densified hard/dense soils (Sandstone) Subgrade

Light Duty Pavements (TI = 4.0) – Parking Stalls

3" Asphaltic Concrete 4" Aggregate Base (AB - 3/4" or 1" minus Crushed Rock) Geotextile Support Fabric (ACF 180, S200 or Equivalent) Re-densified hard/dense soils (Sandstone) Subgrade
When founded over **redensified clay soils**, an R-value of 5 was used for the following designs:

Heavy Duty Pavements (TI = 7.5) – Main Entrance Access Lane

4" Asphaltic Concrete
6" Aggregate Base (AB - 3/4" or 1" minus Crushed Rock)
20" Aggregate Subbase (ASB - 4" minus Crushed Rock or approved equivalent)
Woven Geotextile Support Fabric (ACF 180 or Equivalent)
Properly Prepared Clay Subgrade

Standard Duty Pavements (TI = 5.5) – Parking Lot Access

3" Asphaltic Concrete
6" Aggregate Base (AB - 3/4" or 1" minus Crushed Rock)
16" Aggregate Subbase (ASB - 4" minus Crushed Rock or approved equivalent)
Woven Geotextile Support Fabric (ACF 180 or Equivalent)
Properly Prepared Clay Subgrade

Light Duty Pavements (TI = 4.0) – Parking Stalls

3" Asphaltic Concrete

4" Aggregate Base (AB - 3/4" or 1" minus Crushed Rock) 16" Aggregate Subbase (ASB - 4" minus Crushed Rock or approved equivalent) Woven Geotextile Support Fabric (ACF 180 or Equivalent) Properly Prepared Clay Subgrade

Note: Alternative subbase (ASB) materials, generally consisting of organic-free, nonexpansive, compactable <u>granular</u> material and which meet the criteria in *Section 9.0, Structural Fill Specifications*, is typically acceptable for this purpose. <u>It appears the onsite undocumented crushed rock fill materials, which are clear of organics and debris,</u> <u>may be acceptable for use as ASB structural fill, pending on-site review, lab</u> <u>testing/verification and approval by the geotechnical engineer or his representative.</u>

8.12.3 General Recommendations

Subgrade Preparation. The subgrade shall be shaped to a uniform surface running reasonably true to established line and grade described in the contract documents. Areas so specified must be redensified and/or backfilled with structural fill. It is important that dense, stable conditions of the subgrade be maintained until the subgrade is covered with the subbase aggregate. Subgrade preparation shall include cleaning, redensification to at least 95% of ASTM D-698 and proofrolling (as described earlier in this report) to identify soft and disturbed subgrade areas. Also, all areas with clay soils must be kept in a moist and fully swelled condition.

After subgrade preparation is completed, the exposed subgrade prepared for the pavement crushed rock support section shall demonstrate a firm and unyielding condition as shown by proofrolling.

Soft or loose materials disturbed during the site preparation process, incapable of achieving the compaction criteria, shall be removed to appropriate bearing materials prior to replacing with structural fill. Where loose or softened subgrade areas are identified, the area shall be over-excavated and replaced with imported granular fill with less than 7 percent (5% during wet weather) passing the number 200 sieve.

<u>It shall be noted that in no case shall construction trucks be allowed to "run" directly on</u> <u>top of the subgrade soils until they are covered with rock</u>. This will likely result in the disturbance of the subgrade soils due to the heavily loaded vehicles (which will likely result in additional over-excavation to remove softened soils). We recommend covering the subgrade soils with <u>at least</u> 8 inches of crushed rock or "shale" over the woven fabric prior to light construction truck traffic traversing the area. Therefore, construction traffic must be carefully coordinated in order to minimize disturbance to the underlying finegrained soils.

Geotextile Fabric Placement. When the subgrade soils have been properly prepared, all areas shall be covered with the woven geotextile support fabric. We recommend a fabric such as ACF 180 or equivalent. The fabric shall be laid longitudinally with the drive lanes. All ends and edges shall be overlapped a minimum of 5 and 2 feet, respectively. Fabric layout shall be such that it "runs" <u>aligned with the lane traffic directions</u>. Care must be taken to not damage the fabric. In no case shall track vehicles be allowed on the fabric. At least 8 inches of rock (12 inches during wet weather) shall be over the fabric prior to allowing truck traffic in the area. Then the traffic shall be light to protect the subgrade. Be careful not to disturb the subgrade when compacting the rock.

Wet Weather Construction. We recommend that for construction during wet weather, in all construction roads and drive lanes where truck traffic will concentrate, the subgrade shall be covered with the woven geotextile support fabric (ACF 180 or equivalent) and at least 18 inches of imported, granular 4-inch minus crushed rock (ASB). Compaction of the fill shall not begin until a minimum of 8 inches of rock is placed above the fabric. Compact carefully so as not to disturb the subgrade. This will provide an adequate working surface and help protect the subgrade from damage from construction traffic. Even light construction traffic shall not be allowed to traverse the area until the minimum of 12 inches of compacted material has been placed and compacted over the support fabric.

Note: If construction traffic begins to "pump" the subgrade soils, construction "haul roads" with 24" or more of crushed rock over fabric shall be established. These are particularly helpful near the structure where concrete trucks and lift trucks will be situated during building construction. The excess rock on these "roads" may be pulled off and used in the AC areas when final rock placement takes place.

Note: It is the contractor's responsibility to protect the subgrade from the truck traffic during all weather until the project has been completed.

Materials. All materials used and construction techniques applied at the site must result in conditions as assumed for design of the pavement sections. We recommend materials used in the pavement support sections be as listed in *Section 9.0*.

We recommend avoiding the use of soft rock or subrounded and/or sandy gravel materials for the aggregate base (AB) rock, since they typically do not perform well in supporting asphaltic pavement sections (i.e., usually do not meet CBR requirements).

Installation of utilities and other site work, which may compromise the integrity of the support fabric or completed base rock sections, shall be avoided when possible. Therefore, utilities which must cross through these areas shall be placed and backfilled before fabric and base rock are placed.

We recommend that the prepared subgrade and subbase backfill be viewed and proofrolled by a representative of The Galli Group, as fill placement progresses. We recommend the base rock be tested for density and stability by a representative of The Galli Group prior to placement of asphalt at the site.

Drainage. Adequate provisions shall be made to direct surface water away from the pavement section and subgrade. Ponded water adjacent to the asphalt areas can saturate the subgrade resulting in loss of support. Therefore, we recommend the areas along the edge of the asphalt be well drained. All paved areas shall be sloped and drainage gradients maintained to carry surface water to catch basins or ditches for transmission off the roadway and parking areas. Excessive landscape watering can also saturate the subgrade and decrease pavement life. Deep curbs, drip irrigation and/or use of dry-land plants will mitigate these affects.

Maintenance. Pavement life can be extended by providing proper maintenance and overlays as needed. Cracks in the pavement shall be filled to prevent intrusion of surface water into the subbase. Asphalt pavements typically require seal coats or overlays after 10 to 12 years to maintain structural performance and aesthetic appearance.

9.0 MATERIALS SPECIFICATIONS

The following materials specifications shall apply to the materials as used on this project, as specified in this report and on project plans or specifications.

Aggregate Base Rock (AB) Structural Fill

- Angular Crushed Rock (³/₄ or 1" Minus); R=85 or greater; Well Graded (No Gaps and at least 60% retained on the No. 4 sieve)
- Exceeds the fracture, durability and sand equivalent requirements outlined in Section 00641 of the Oregon Standard Specifications for Construction
- Maximum passing the No. 200 sieve $\leq 5\%$
- Compacted to 98% of the maximum dry density as determined by ASTM D698 or AASHTO T-99

Aggregate Subbase Rock (ASB) Structural Fill

- Angular Clean Crushed (jaw run) hard "Shale" (4" Minus Jaw-Run) or Crushed Rock (2" to 4" Minus); R=50 or greater; Angular and Reasonably Well Graded
- At Least 60% retained on the No. 4 Sieve.
- Exceeds the fracture, durability and sand equivalent requirements outlined in Section 00641 of the Oregon Standard Specifications for Construction
- Maximum passing the No. 200 sieve $\leq 10\%$ Total; $\leq 3\%$ Clay Size
- During wet weather; passing No. 200 sieve $\leq 5\%$.
- Compacted to 95% of the maximum dry density as determined by ASTM D698 or AASHTO T-99; initial lift may not attain 95% due to soft subgrade; Engineer to decide in the field.
- Care must be taken to avoid very silty subbase that will not support construction loads, especially when wet (will not meet specifications).

Embankment Fill (Acceptable for Structural Fill During <u>Dry</u> Weather)

- Reasonably well graded (not open work)
- Has at least 60% retained on the No. 4 sieve.
- Has no more than 30% passing No. 200 sieve.
- Passing No. 200 sieve must have less than 20% clay size.

On-Site Soil Fill

- Pulverized (4" minus or smaller) hard Sandstone as specified in the report [beneath exterior flatwork or for general site/landscape grading].
- Pulverized (4" minus or smaller) concrete (free from rebar) as specified in the report [beneath exterior flatwork or for general site/landscape grading].
- Approved, on-site granular fill (less organics, silt, clay and debris) as specified in the report [asphalt ASB section, pending review, testing and approval].
- (NO CLAY OR SILT SOILS)
- Not below footings.

Imported "Clean" Sand

- Clean washed sand or sand and gravel, less than 3% passing No. 200.
- Gravel to be rounded or subrounded (no fracture faces), 1" or less.
- Must have less than 30% gravel by weight.

Note: Some fill materials will be difficult to nearly impossible to compact during wet weather. *The contractor <u>must</u> select the type of structural fill that will be able to be placed and compacted to specified conditions during the weather conditions that can take place during the construction schedule.*

Drain Rock (For Drainage Sections)

- Clean washed rounded or angular openwork drain rock.
- Gradation to be 1/4" and greater, sized to not move into and through perforations in the pipe.
- 1/4" to 3/4" clean crushed, 3/4" to 1" clean rounded rock, 1" to 2" clean angular rock are all acceptable.
- Clean means washed rock with <u>NO</u> coating of silt, clay or sand.

Note: All types may be used in all applications of drain rock that are <u>not</u> beneath Asphaltic Concrete paved areas. In all AC areas <u>angular</u> clean drain rock must be used for AC support. Beneath floor slabs the drainage layer drain rock must be <u>angular</u> clean drain rock.

Geotextile Filter Fabric

- Non-woven geotextile filter fabric for wrapping drainage sections and separation of openwork rock from sands or soils fines.
- Meet specifications as per Mirafi 140N or equivalent.
- Overlap all edges at least 24 inches (12" for drainage section envelope).
- Secure in place such that overlaps will not move during covering operation.

Geotextile Support Fabric

- Woven geotextile support fabric designed for separation of crushed rock and subgrade soil and for rock section support.
- Meet specifications as per ACF180 woven support fabric.
- Overlap edges at least 2 feet and ends at least 5 feet.
- Align roll lengthwise with direction of traffic in all drive lanes.
- Pull tight full length and keep tight during placement of crushed rock above fabric.
- Do not drive on the fabric until it is covered with rock.

Perforated Pipe

- 3", 4" or 6" rigid wall, smooth interior perforated pipe.
- Secure all joints with solvent weld glue. <u>DO NOT</u> use only compression push together fittings.
- Slope to drain per specifications in report or on plan sheets.
- Align perforations in the downward direction.
- <u>Must</u> always be placed within filter fabric wrap unless specifically specified otherwise.

• Protect from construction traffic until buried at least 2 times pipe diameter (minimum 8 inches) of angular rock fill.

Wall Sheet Drain

- Polymer sheet drain with filter fabric attached 1 or 2 sides, designed for drainage of vertical embedded foundation or retaining walls.
- For walls up to 10 feet tall. Must meet specifications as for American Wick Drain's AMERDRAIN 200 or 220.
- Install and splice and patch per manufacturer's recommendations.
- Install with fabric side towards the backfill.
- Attach to wall per manufacturer's recommendations.
- Extend down wall all the way to bottom of drainage section around perforated
- Protect from damage when backfilling with crushed rock larger than 2-inch minus.
- Repair all damaged areas prior to final backfill.

Asphaltic Concrete

- Type 2 Dense Graded HMAC
- PG 64-22
- The 4" AC may be placed in 1 lift if vibratory rollers are used.
- Compacted to between 91% and 95% of "Maximum Specific Gravity" for first courses; between 92% and 95% for wearing course.
- Must have densification completed while temperature is above 185 degrees F.
- Do not over densify as this will significantly decrease frost heave protection of internal air voids.
- The contractor must provide a HMAC design mix for review and approval.
- All aspects of the asphaltic paving shall be accomplished in accordance with applicable ODOT standards and recommendations.

NOTE: All such materials to be used on the project <u>must</u> be submitted for compliance testing or review, at least two weeks prior to use at the site. Deviations from specified materials must be approved in writing by the geotechnical engineer, owner, and the owner's other consultants/design engineers prior to use.

10.0 SITE DRAINAGE

<u>The site shall be graded during construction such that surface water does not pond within</u> <u>the building footprint or pavement areas</u>. Surface runoff shall be controlled during construction and with final site grading. All areas adjacent to the structures shall be designed to have a permanent slope away from the foundations at an inclination of at least 6 inches in eight (8) feet. All surface water shall be channeled into landscape area drains or catch basins, or shall be conveyed around the structures to appropriate disposal locations. Where items such as landscape areas and walkways block the flow of surface water, small area drains shall be installed to collect the surface runoff. Good site design accommodates all site runoff and conveys it away from the structures and off the site to an acceptable disposal location without undue erosion problems.

All roof downspouts shall be connected to a sealed tightline system, which discharges to an acceptable disposal location. In no case shall these be connected to footing drains or subdrains beneath floors.

11.0 EROSION CONTROL

The site soils are moderately to highly susceptible to erosion. The site grades are relatively flat, especially in the area which will be disturbed by construction. Therefore, site erosion should be low to moderate.

Construction Erosion Control. All disturbed areas shall have the low side surrounded by a silt fence or erosion control bags. At select locations settling ponds of hay-bale backed silt fence shall be established to decrease silt content of water flowing off site. Hay bales or wattles shall be used to protect street catch basins or cross culverts within 300 feet of the site.

The site will also require crushed rock (or shale) construction entrances to prevent construction vehicle "tracking" of mud onto the city streets. These are typically required to be 50 feet long and be constructed of a 12" to 18" thick section of angular open-work rock over a woven fabric (more if needed to protect the subgrade soils).

Permanent Erosion Control. Permanent project landscaping and paving as required by the City of Medford will usually meet most needs of long-term erosion control. All disturbed areas on the site but outside the developed area of the project must be reseeded with local native grasses for erosion prevention. These areas shall be graded reasonably smooth and the surface scarified to ½ inch deep. The area shall then be hydroseeded with a combination of erosion control grass seed, fertilizer and mulch. Alternatively, and at a minimum, these areas should be covered with a thin layer of crushed rock.

12.0 ADDITIONAL SERVICES AND LIMITATIONS

12.1 ADDITIONAL SERVICES

We should review construction plans and specifications for this project as they are being developed. In addition, The Galli Group should be retained to review all geotechnical-related portions of the plans and specifications to evaluate whether they are in conformance with the recommendations provided in our report. Additionally, to observe compliance with the intent of our recommendations, design concepts, and the plans and specifications, all construction operations dealing with earthwork, foundations and rock placement and compaction should be observed by a representative from The Galli Group.

For this project, we anticipate additional services may include the following:

- Review of final construction plans and specifications for compliance with geotechnical recommendations and to verify adverse conditions are not created. <u>Such review must be accomplished prior to start of construction bidding</u>.
- Possible project team meetings to clarify issues and proceed smoothly into and through the construction process. This would include the preconstruction meeting where contractor clearly understands what is expected from a geotechnical perspective.
- Observation of onsite excavations and trenches to verify conditions/stability.
- Observation and/or testing of over-excavated areas, subgrade preparation, subgrade proofrolling, structural fill placement, pavement subgrade preparation, footing subgrade verification, aggregate base placement and compaction, site grading, surface drainage, wall and floor drainage.
- Redesign of portions of the project as required.
- Periodic construction field reports, as requested by the client and required by the building department.

We would provide these additional services on a time-and-expense basis in accordance with our current Standard Fee Schedule and General Conditions at the time of construction. If we are not retained to provide these services, we cannot be held responsible for the decisions by others or geotechnical related issues in the constructed product that we did not verify.

12.2 LIMITATIONS

The analyses, conclusions and recommendations contained in this report are based on site conditions and assumed development plans as they existed at the time of the study, and assume soils, rock and groundwater conditions exposed and observed in the borings and test pits during our investigation are representative of soils and groundwater conditions throughout the site. If during construction, subsurface conditions or assumed design information is found to be different, we should be advised at once so that we can review this report and reconsider our recommendations in light of the changed conditions. If there is a significant lapse of time between submission of this report and the start of work at the site, if the project is changed, or if conditions have changed due to acts of God or construction at or adjacent to the site, it is recommended that this report be reviewed in light of the changed conditions and/or time lapse.

This report was prepared for the use of the owner and developer and their design and construction team for the design and construction of the project. It should be made available to contractors for information and factual data only. This report shall not be used for contractual purposes as a warranty of site subsurface conditions. It shall not be used at other sites or for projects other than the one intended.

We have performed these services in accordance with generally accepted geotechnical engineering practices in southern Oregon, at the time the study was accomplished. No other warranties, either expressed or implied, are provided.

THE GALLI GROUP GEOTECHNICAL CONSULTING

Demisfun

Dennis Duru, M.Sc., R.G., C.E.G. Engineering Geologist

Lyn Chand

Lyn Chand, P.E. Project Engineer

Fal

Melvin Galli, III, P.E. Principal Engineer

















BACKSLOPE EXTERIOR SURFACES AT LEAST 2% TO 5% FOR A MINIMUM OF 6 FEET

STANDARD WALL DRAIN CONSISTING OF 12" WIDE (AT LEAST) WASHED DRAIN ROCK WRAPPED IN A NON-WOVEN GEOTEXTILE FABRIC (4 to 5 OZ. PER SQUARE FOOT; Mirafi 140N OR EQUIVALENT). TO WITHIN 6"

> ALTERNATIVE TO STANDARD WALL DRAIN: RETAINING -WALL BACKFILL SHALL CONSIST OF COMPACTED GRANULAR BACKFILL WHICH MUST BE FULLY FREE-DRAINING MATERIAL AND MUST EXTEND DOWN TO THE BASE DRAINAGE SECTION; THIS ALTERNATIVE ALSO MUST INCLUDE THE WALL MAT/SHEET DRAIN AND WALL SEAL, DESCRIBED ON THIS SHEET.

ALTERNATE FOOTING/BASE DRAIN LOCATION WITH SOMEWHAT LESS EFFECTIVENESS.

NOTE: 2" CLEAN SAND OVER THE FABRIC PROTECTS IT DURING BACKFILL OPERATIONS.

CLEAN $1"-1\frac{1}{2}"$ WASHED DRAIN ROCK AT LEAST 8" ABOVE AND BESIDE THE PIPE, AS SHOWN (NOT BELOW PIPE).

NON-WOVEN GEOTEXTILE FILTER FABRIC (4 to 5 OZ. PER SQUARE FOOT) - OVERLAP AND SECURE.

4" DIAMETER (3" ON SMALLER WALLS), RIGID, SMOOTH WALL, PERFORATED PIPE (HOLES DOWN) WITH SOLVENT-WELDED CONNECTIONS: INSTALL CLEAN-OUTS AT BOTH ENDS FOR LONG-TERM MAINTENANCE: SLOPE FOR POSITIVE DRAINAGE AND ORIENT THE PERFORATIONS FACING DOWN

RETAINING WALL	DATE: JULY 2022	FIGURE:
CBOSS-SECTION	JOB NO: 02-6139-01	
	REV: 7/27/2022 11:05 AM	
RANSPORTATION DISTRICT	PREPARED BY: NG	
ORD, OREGON	6139 Rogue Valley Transportation District - 06 - retwall drain-basement.dwg	

APPENDIX A

BORING & TEST PIT LOGS

THE GALLI GROUP GEOTECHNICAL CONSULTANTS



 Project: 3200 Crater Lake Avenue - Medford

 Client: Rogue Valley Transportation District

 Location: See Figure 3, Site Plan with Exploration Locations

 Driller: TGG - Ken and Blake

 Drill Rig: ATV Mounted, 4" SSA

 Depth To Water>
 Initial \arrow : none

Project No.: 02-6139-01 Date: 06/15/2022 Elevation: Logged By: Lyn Chand

Depth To	Water>	Initial $\stackrel{\nabla}{=}$: none	At Completion : none								
Graphic					Sample		Stand	ard Per	netratio	n Test	
Log	USCS	Description		Depth	No. and Type	NMC	N	С	URV	E	
				0	.,,,,,			10	30	50	
	VG	Crushed rock gravel and scattered vegetation.	0.5	-0							
	FILL	(Rootzone)	0.5	-							
		Dense, brown, silty Clay and Gravel; damp.		-							
			1 75	-							
	SM	Dense to very dense, light brown, silty Sand:	1.75	_ 2							
		damp. (highly weathered/decomposed		2							
		Sandstone)	0.0	-	S-1	8.8	50				
		Bottom of boring at 3.0 feet, auger refusal	3.0	-		0.0					
		No groundwater or seepage observed.		-							
				- 1							
				•							
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				-					$\left \right $		
				L 14		π		<u> </u>			
Legend of	Sampl	ers: [] Grab sample [] SF	'I sam	nple		⊥ S	nelby	/ tube	samp	DIE	
Several att	empts a	nd multiple locations, debris and large gravels and	d cobbl	les pres	ent.						

THE GALLI GROUP GEOTECHNICAL CONSULTANTS



 Project: 3200 Crater Lake Avenue - Medford

 Client: Rogue Valley Transportation District

 Location: See Figure 3, Site Plan with Exploration Locations

 Driller: TGG - Ken and Blake

 Drill Rig: ATV Mounted, 4" SSA

 Depth To Water>
 Initial \arrow : none

Project No.: 02-6139-01 Date: 06/15/2022 Elevation: Logged By: Lyn Chand

Depth To	Water>	Initial $\stackrel{\nabla}{=}$: none	At Completion 🚆 : none							
Graphic				Sample		Stand	ard P	enetra	tion	Test
Log	USCS	Description	Depth	No. and Type	NMC	N		CUR	VΕ	
			_	Турс			10	30		50
	VG	Crushed rock gravel and scattered vegetation.	0					TĪ		
	FILL	(Rootzone)	-							
		Dense, brown, silty Clay and Gravel; with <u>1.0</u>	-	F	1	50				•
		obstruction, unable to collect a sample	_							
		Bottom of boring at 1.0 feet due to auger								
		refusal in gravels/cobbles or concrete debris.	-2							
		No groundwater or seepage observed.	-							
			-							
			_							
			-4							
			-							
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			_ 14							
Legend of	Sample	ers: 📋 Grab sample 🛛 🖉 SPT san	nple		⊥ s	Shelby	/ tub	e sar	nple	e
Several att	empts a	nd multiple locations, debris and large gravels and cobb	les pres	ent.						

This information pertains only to this boring and should not be interpreted as being indicative of the site.

TEST PIT LOG

			Test Pit No.: TP-1		
PROJECT				PRO	JECT NO.
	3200	Crater I	Lake Avenue - Medford	DAT	02-6139-01
LIENI	D	X 7 - 11		DATE	-
LOCATION	Rogue	e valley	ransportation District	ELE\	<u>06/15/2022</u> /.
	See Figure 3	, Site Pl	an with Exploration Locations		
EXCAVATI	ON METHOD			LOG	GER
<u>К</u> СЕРТН ТО	ubota U35.4 Mi - Water: none	<u>ni Exca</u> Wh	wator with 2-foot rock tooth bucket en checked: 06/15/2022 Caving:	none	Lyn Chand
	SOIL SYMBOLS	1			
.EVATION/		USCS	DESCRIPTION		
DEPTH	GRAPHIC TO A				pcr %
		EILI	Dansa 4 inch minus crushed rock (EII I)		
-			Dense, 4-men minus, crusica lock. (FILL)		-
_		SC	Stiff, dark gray, sandy Clay; concrete debris, moi	st.	_
-			(Not sampled)		-
2.5			Bottom of test pit at 1.3'. No groundwater or seepage observed.		
_					+
-					-
- 5					
_					-
_					+
_					-
- 7.5					
-					-
_					-
- 10					
-					-
-					+
-					+
- 12.5					-
_					+
-					
F					
s: Test F	Pits 1-4 were ver	ry shall	ow for preliminary sampling until explorate	ion with	h larger
equip	ment could be a	ccompl	isnea.		
			The Galli Group		

			Test Pit No.: TP-2			
PROJECT				PRO	JECT NO).
	320	0 Crater I	Lake Avenue - Medford		02-6139	9-01
CLIENT				DATI	Ξ	
	Rog	gue Valley	Transportation District		06/15/2	022
LOCATION				ELE	/.	
EXCAVATI	See Figure	e 3, Site P	an with Exploration Locations		GER	
	where $U25.41$	Mini Eno	water with 2 foot rook to oth hughot			and
DEPTH TO	- Water: non	e Wh	en checked: 06/15/2022 Caving	: none	Lyn Cn	and
<u></u>	SOIL SYMBOLS	6				
ELEVATION/	AND SAMPLER	S Z USCS	DESCRIPTION		DENSITY	MOISTURE
DEPTH		RIVE	DESCRIPTION		pcf	%
0						
		FILL	Dense, 4-inch minus, crushed rock. (FILL)		-	_
-		СН	Stiff, dark brown, silty Clay; moist. (FILL)			
-	444	<u>sc</u>	Stiff, dark gray, sandy Clay, small debris, moist (Not sampled)	. (FILL)	-	-
-			Bottom of test pit at 1.3'.		-	-
2.5			No groundwater or seepage observed.			-
-					-	-
-					-	-
-					-	-
5						_
-					-	-
-					-	-
-					-	-
_ /.5						
-					-	-
-					-	-
-					-	-
-					-	-
_					-	-
-					-	ł
- 12.5					-	F
-					-	ŀ
-					-	ł
- -					-	+
tes: Test F equip	Pits 1-4 were ment could be	very shall e accompl	ow for preliminary sampling until explorations is hed.	tion wit	h larger	
			The Galli Group			

				Test Pit No.: TP-3			
PROJECT					PRO	JECT NO	Э.
		3200	Crater I	.ake Avenue - Medford		02-6139	9-01
CLIENT							
	F	Rogue	e Valley	Transportation District		06/15/2	022
LOCATION	а г'	2	0'4 DI			v.	
EXCAVATIO	See Fig	ure <u>3</u> DD	, Site Pl	an with Exploration Locations	LOG	GER	
Kı	ubota U35	.4 Mi	ini Exca	vator with 2-foot rock tooth bucket		Lyn Ch	and
DEPTH TO	- Water: n	one	Wh	en checked: 06/15/2022 Caving	none	2	
	SOIL SYME						
LEVATION/		EN LK	USCS	DESCRIPTION		DENSITY pcf	MOISTURE %
DEPTH	GRAPHIC	DRIV					
			FILL	Dense 4-inch minus crushed rock (FILL)			
-				Stiff dark brown sandy Clay with rounded gray	vale	-	32.1
_		.		moist.	1015	-	- 52.1
-				Sample S-1, bucket. EI=91: Highly Expansive Clay		-	+
- 2.5				Bottom of test pit at 1.3'.		-	_
				No groundwater or seepage observed.		-	
							Į.
-						-	-
- 5						-	
_						-	+
_						-	-
-						-	-
- 7.5						-	
						-	
-							Ļ
-						-	ł
- 10						-	
F						-	+
F							+
F						-	ł
12.5						-	<u> </u>
-						-	ŀ
-						-	+
F						-	ł
es: Test P	Pits 1-4 we	re ve	rv shall	ow for preliminary sampling until explorat	tion wit	h larger	
equip	ment could	l be a	iccompl	ished.			
				The Galli Group			

TEST PIT LOG

			Test Pit No.: TP-4			
PROJECT				PRO	JECT NO).
	3200	Crater I	_ake Avenue - Medford		02-6139	9-01
CLIENT				DATI	E	
	Rogu	e Valley	Transportation District		06/15/2	022
LOCATION				ELE	V.	
EXCAVATI	See Figure 3	3, Site Pl	an with Exploration Locations	LOG	GER	
K	ubota U35 4 M	ini Exca	vator with 2-foot rock tooth bucket		Lvn Ch	and
DEPTH TO	- Water: none	Wh	en checked: 06/15/2022 Caving:	none	Lyn en	
	SOIL SYMBOLS	1				
ELEVATION/	AND SAMPLERS		DESCRIPTION		DENSITY	MOISTURE
DEPTH		0303	DESCRIPTION		pcf	%
_		FILL	Dense, 4-inch minus, crushed rock. (FILL)		-	-
_		SP/GP	Mixture of sand and gravel with very large pieces of concrete. (FILL)	of	-	-
_		SM	Medium dense, light brown, silty Sand; damp. (FIL	L) _		τ 18.1
- 2.5		СН	Sample S-1, bag. Stiff, dark gray, sandy Clay: moist.	/	_	- 36.5
_			Sample S-2, bucket.		-	_
_			EI=57, Expansive Clay Bottom of test pit at 3 5'			
_			No groundwater or seepage observed.		_	_
- 5					_	_
_					-	_
-					-	-
-					-	_
-					-	_
-7.5					_	_
					_	_
_					-	_
-					-	-
- 10					-	_
_					-	_
-					-	_
-					-	_
12.5					_	_
12.3					_	_
_					-	-
-					-	_
F					-	-
toe: T / T):4- 1 4		<u>1</u> ::	•	1. 1.	<u> </u>
eauin	us 1-4 were ve ment could be a	ery snatt accompl	ow jor preuminary sampling until exploratio ished.	n Wit	n iarger	
equip:		pi				

				Test Pit No.: TP-5			
PROJECT					PRO	JECT NO).
	32	00 0	Crater L	Lake Avenue - Medford		02-6139	9-01
CLIENT							
	Ro	gue	Valley	Transportation District	FI F\	06/21/2	022
200/(1101)	Soo Figur		Sita Dl	an with Exploration Locations		· .	
EXCAVATIO	ON METHOD	<u>e 5,</u>			LOG	GER	
Hit	achi ZX120	Exc	cavator	with 2-foot wide, rock tooth bucket		Lyn Ch	and
DEPTH TO	- Water: nor	ne	Wh	en checked: 06/21/2022 Caving: r	none		
	SOIL SYMBOL AND SAMPLE	LS RS					
DEPTH	GRAPHIC	IVEN	USCS	DESCRIPTION		DENSITY pcf	MOISTURE %
		DR					
		4	FILL	Dense, 3/4-inch minus, crushed rock and grass. (FII	LL) _		
_			SM/SC	Dense, orange-brown, clayey, silty Sand; with debr	is,	-	-
-				Sample S-1. bag.		-	13.1
-			D 0 011			-	
- 2.5			NOCK	SANDSTONE, orange-brown, moderately weather medium hard to hard (R3-R4). (Payne Cliff Format	ed, ion).	_	<u>n/a</u>
-				Sample S-2, bag.		-	-
-				No groundwater or seepage observed.		-	_
- 5						-	-
-						-	-
-						-	_
						-	_
- 7.5						_	_
-						-	-
_						-	_
						-	_
- 10						-	_
-						-	_
_						-	-
F						-	-
- 12.5						-	-
_						-	-
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es:						1	<u> </u>
				The Galli Group			

				Test Pit No.: TP-6			
PROJECT					PRO	JECT NO).
	320	00 Cra	ater L	ake Avenue - Medford		02-6139	9-01
CLIENT					DATE	Ξ	
LOCATION	Rog	gue V	alley	Transportation District	ELE\	<u>06/21/2</u> /.	022
	See Figure	- 3 Si	ito Dl	an with Exploration Locations		•	
EXCAVATIO	ON METHOD				LOG	GER	
Hit	achi ZX120	Excav	vator	with 2-foot wide, rock tooth bucket		Lyn Ch	and
DEPTH TO	- Water: non	ie	Wh	en checked: 06/21/2022 Caving: 1	none		
ΕΙ ΕΙ/ΑΤΙΟΝ/	SOIL SYMBOLS	S S					
DEPTH		U NEN	JSCS	DESCRIPTION		DENSITY pcf	MOISTURE
		DRI					
$\begin{bmatrix} 0 \end{bmatrix}$		F	FILL	Dense, 3/4-inch minus, crushed rock and grass. (FI	LL)		
-		SN	M/SC	Medium dense, brown, clayey, silty Sand; with cob	bles,		
_				plastic and metal debris, moist. (FILL)		-	_
_						-	_
- 2.5				Sample 1, bag.			15.3
-						-	_
-			Rock	SANDSTONE, light brown, moderately weathered	. 1		n/a
- 5				medium hard to hard (R3-R4). (Payne Cliff Format	ion).	_	
- 5				Bottom of test pit at 4.2'.		-	_
-				No groundwater or seepage observed.		-	-
-						-	_
- 7.5						_	_
-						-	-
_						-	_
_						-	_
- 10						_	_
_						-	_
_						-	-
_						-	-
- 12.5						_	_
-						-	-
_						-	_
-						-	-
ites:		I					
				The Galli Group			

PROJECT PROJECT NO. 3200 Crater Lake Avenue - Medford 02-6139-01 CLIENT DATE Rogue Valley Transportation District 06/21/2022 LOCATION ELEV. EXCAVATION METHOD LOGGER Hitachi ZX120 Excavator with 2-foot wide, rock tooth bucket Lyn Chand DEPTH Soll SYMBOLS GRAPHIC Y Y Y SOL SYMBOLS DESCRIPTION DEPTH GRAPHIC O FILL GRAPHIC Y SSOL SYMBOLS SSOL SYMBOLS SSOL SYMBOLS DESCRIPTION DEPTH SSOL SYMBOLS SOL SYMBOLS DESCRIPTION DEPTH SSOL SYMBOLS GRAPHIC Y SSOL SYMBOLS DESCRIPTION DENSITY MOISTUF DENTY MOISTUF SSOL SYMBOLS SSOL SYMBOLS AND SAMPLERS USCS DEPTH GRAPHIC C Y SSOL SYMBOLS SSOL SYMBOLS SSOL SYMBOLS SSOL SYMBOLS MOISTUF DESCRIPTION DENSITY MOISTUF SSOL SYMBOLS SSOL SYMBOLS SSOL SYMBOLS SSOL SYMOLS
3200 Crater Lake Avenue - Medford 02-6139-01 CLIENT DATE Rogue Valley Transportation District 06/21/2022 LOCATION ELEV. See Figure 3, Site Plan with Exploration Locations ELEV. EXCAVATION METHOD LOGGER Hitachi ZX120 Excavator with 2-foot wide, rock tooth bucket Lyn Chand DEPTH Soil SYMBOLS DESCRIPTION DENSITY MOISTUF Work Soil SYMBOLS MOISTUF Soil SYMBOLS USCS DESCRIPTION DENSITY MOISTUF DEPTH Soil SYMBOLS USCS DESCRIPTION DENSITY MOISTUF 2.5 SOIL SYMBOLS USCS DESCRIPTION DENSITY MOISTUF 2.5 SOIL SYMBOLS Some wood and concrete debris, moist. (FILL) 18.1 2.5 SC Medium dense, light brown clayey Sand; moist. (FILL) 18.1 5 CH Medium dense, dark brown, rounded, gravelly Clay; moist. 40.8 5 CH Medium dense, dark brown, rounded, gravelly Clay; moist. 40.8
CLIENT DATE Rogue Valley Transportation District 06/21/2022 LOCATION ELEV. ELEV. EXCAVATION METHOD LOGGER Hitachi ZX120 Excavator with 2-foot wide, rock tooth bucket Lyn Chand DEPTH TO - Water: none When checked: 06/21/2022 Caving: none ELEVATION/ SOIL SYMBOLS AND SAMPLERS AND SAMPLERS USCS DESCRIPTION ELEVATION/ GRAPHIC Image: Solid Symbols Signification Location set (FILL) MOISTUF pcf 0 Image: Solid Symbols Signification Signification Location set (FILL) Image: Solid Symbols Signification Signification Set (FILL) Image: Solid Symbols Signification Set (FILL) 0 Image: Solid Symbols Signification Signification Set (FILL) Image: Solid Symbols Signification Set (FILL) Image: Solid Symbols Signification Set (FILL) 0 Image: Solid Symbols Signification Set (FILL) Image: Solid Symbols Signification Set (FILL) Image: Solid Set (FILL) 0 Image: Solid Symbols Signification Set (FILL) Image: Solid Set (FILL) Image: Solid Set (FILL) Image: Solid Set (FILL) 0 Image: Solid Set (FILL) Image: Solid Set (FILL) Image: Solid Set (FILL) Image: Solid Set (FILL) 1 Image: Solid Set (FILL) Image: Solid Set (FILL) Image: Solid Set (FILL) Image: Solid Set (FILL) 1
Rogue Valley Transportation District 06/21/2022 LOCATION ELEV. See Figure 3, Site Plan with Exploration Locations ELEV. EXCAVATION METHOD LOGGER Hitachi ZX120 Excavator with 2-foot wide, rock tooth bucket Lyn Chand DEPTH TO - Water: none When checked: 06/21/2022 Caving: none ELEVATION/ SOIL SYMBOLS AND SAMPLERS GRAPHIC USCS DESCRIPTION SOIL SYMBOLS AND SAMPLERS GRAPHIC USCS DESCRIPTION DENSITY Pcf MOISTUF Pcf 0 FILL Grass covered organic topsoil. (ROOTZONE) DENSITY %6 MOISTUF Pcf 2.5 SC Medium dense, dark brown, clayey, silty Sand; some wood and concrete debris, moist. (FILL) 18.1 -2.5 SC Medium dense, dark brown, rounded, gravelly Clay; moist. 40.8 -5 CH Medium dense, dark brown, rounded, gravelly Clay; moist. 40.8
LOCATION See Figure 3, Site Plan with Exploration Locations EXCAVATION METHOD LOGGER Hitachi ZX120 Excavator with 2-foot wide, rock tooth bucket Lyn Chand DEPTH TO - Water: none When checked: 06/21/2022 Caving: none ELEVATION/ SOIL SYMBOLS AND SAMPLERS USCS DESCRIPTION DENSITY pdf MOISTUF % DEPTH GRAPHIC Description DESCRIPTION DENSITY pdf MOISTUF % 0 FILL Grass covered organic topsoil. (ROOTZONE) Image: Covered organic topsoil. (ROOTZONE) Image: Covered organic topsoil. (FILL) Im
See Figure 3, Site Plan with Exploration Locations EXCAVATION METHOD LOGGER Hitachi ZX120 Excavator with 2-foot wide, rock tooth bucket Lyn Chand DEPTH TO - Water: none When checked: 06/21/2022 Caving: none ELEVATION/ DEPTH Soil SYMBOLS AND SAMPLERS GRAPHIC USCS DESCRIPTION DENSITY pcf MOISTUF % ELEVATION/ DEPTH Soil SYMBOLS AND SAMPLERS GRAPHIC USCS DESCRIPTION DENSITY MOISTUF MOISTUF 0 FILL Grass covered organic topsoil. (ROOTZONE) Image: Comparison of the second of the sec
Hitachi ZX120 Excavator with 2-foot wide, rock tooth bucket Lyn Chand DEPTH TO - Water: none When checked: 06/21/2022 Caving: none Density Moisture ELEVATION/ DEPTH SOIL SYMBOLS AND SAMPLERS GRAPHIC USCS DESCRIPTION DENSITY pcf MOISTUF % 0 FILL Grass covered organic topsoil. (ROOTZONE) SM/SC Loose to medium dense, dark brown, clayey, silty Sand; some wood and concrete debris, moist. (FILL) 18.1 - 2.5 SC Medium dense, light brown clayey Sand; moist. (FILL) 18.1 - 2.5 CH Medium dense, dark brown, rounded, gravelly Clay; moist. Sample S-2, bag. Expansive Clay. 40.8
DEPTH TO - Water: none When checked: 06/21/2022 Caving: none ELEVATION/ DEPTH SOIL SYMBOLS AND SAMPLERS GRAPHIC USCS DESCRIPTION DENSITY pcf MOISTUF % 0 FILL Grass covered organic topsoil. (ROOTZONE) MOISTUF 2.5 FILL Grass covered organic topsoil. (ROOTZONE) Image: Covered organic topsoil. (ROOTZONE) 2.5 SC Medium dense, light brown clayey sand; moist. (FILL) 18.1 Sample S-1, bag. CH Medium dense, dark brown, rounded, gravelly Clay; moist. 40.8 -5 CH Medium dense, dark brown, rounded, gravelly Clay; moist. 40.8
SOIL SYMBOLS AND SAMPLERS USCS DESCRIPTION DENSITY pcf MOISTUF DEPTH GRAPHIC Y
ELEVATION/ DEPTH AND SAMPLERS GRAPHIC USCS DESCRIPTION DENSITY pcf MOISTUF % 0 FILL Grass covered organic topsoil. (ROOTZONE) SM/SC FILL Grass covered organic topsoil. (ROOTZONE) Image: Comparison of the second of the sec
DEPTH GRAPHIC B <td< td=""></td<>
0 FILL Grass covered organic topsoil. (ROOTZONE) SM/SC Loose to medium dense, dark brown, clayey, silty Sand; some wood and concrete debris, moist. (FILL) 2.5 SC Medium dense, light brown clayey Sand; moist. (FILL) SC Medium dense, light brown clayey Sand; moist. (FILL) SC Medium dense, dark brown, rounded, gravelly Clay; moist. Sample S-1, bag. 40.8 Sample S-2, bag. Expansive Clay.
PILL Grass covered organic topsoil. (ROO12ONE) SM/SC Loose to medium dense, dark brown, clayey, silty Sand; some wood and concrete debris, moist. (FILL) SC Medium dense, light brown clayey Sand; moist. (FILL) SC Medium dense, light brown, rounded, gravelly Clay; moist. CH Medium dense, dark brown, rounded, gravelly Clay; moist. Sample S-2, bag. Expansive Clay.
-2.5 some wood and concrete debris, moist. (FILL) -2.5 SC Medium dense, light brown clayey Sand; moist. (FILL) SC Medium dense, light brown clayey Sand; moist. (FILL) Sample S-1, bag. 18.1 CH Medium dense, dark brown, rounded, gravelly Clay; moist. Sample S-2, bag. Expansive Clay. -
-2.5 SC Medium dense, light brown clayey Sand; moist. (FILL) 18.1 Sample S-1, bag. -1 CH Medium dense, dark brown, rounded, gravelly Clay; 40.8 moist. Sample S-2, bag. - -5 - -
-2.5 SC Medium dense, light brown clayey Sand; moist. (FILL) 18.1 Sample S-1, bag. SC Medium dense, dark brown, rounded, gravelly Clay; 40.8 CH Medium dense, dark brown, rounded, gravelly Clay; 40.8 Sample S-2, bag. Expansive Clay. 40.8
CH Medium dense, dark brown, rounded, gravelly Clay; moist. Sample S-2, bag. Expansive Clay. 40.8
moist. Sample S-2, bag. Expansive Clay.
- 5 Expansive Clay.
GC Medium dense to very dense, orange brown, clayey Gravel; with sand, moist. (Decomposed to Weathered
-7.5 Sandstone).
Sample S-3 hag
Expansive Clay.
AROCK BASALT, gray, slightly weathered, medium hard to very <u>n/a</u> hard (R3-R5). (Little Butte Volcanics Terrane).
- Sample S-4, bag
- 12.5 Bottom of test pit at 11.25'
lotes:
The Galli Group

			Test Pit No.: TP-8					
PROJECT				PRO	JECT NO	D.		
	3200	Crater I	.ake Avenue - Medford		02-6139	9-01		
CLIENT	0200			DATE	02-0139-01 DATE			
	Rogue	Valley	Transportation District		06/21/2	022		
LOCATION	LOCATION							
	See Figure 3	, Site Pl	an with Exploration Locations	100				
EXCAVATION	METHOD			LOG	GER			
Hitacl	hi ZX120 Ex Vater: none	cavator Wh	with 2-foot wide, rock tooth bucket en checked: 06/21/2022 Caving: t	none	Lyn Ch	and		
	SOIL SYMBOLS							
ELEVATION/	ND SAMPLERS				DENSITY	MOISTURE		
DEPTH G		USCS	DESCRIPTION		pcf	%		
		FILL	Dense, 4-inch minus, crushed rock. (FILL)					
-		SC/SM	Medium dense, red-brown, clayey, silty Sand; brick debris at 0.5-0.75 feet damp (FUL)		-			
_			Sample S-1, bag. Expansive Clay.		-	6.3		
-		СН	Stiff, dark gray, sandy Clay; with silt, moist.					
2.5			Expansive Clay			-		
_			Sample S-2, bag.		-	32.1		
-		ROCK	SANDSTONE light brown highly weathered extr	emelv				
-		noon	soft to very soft (R0-R1), fractured and crumbly. (P	ayne	-	-		
5			Cliff Formation). Sample S-3, bag.			18.9		
_					-	-		
-		Rock	SANDSTONE transition to moderately weathered	1,	-	n/a		
-			medium hard (R3).		-	-		
_ 7.5	<u> </u>		Bottom of test pit at 7.5'.	/	-	_		
_			No groundwater or seepage observed.		-	-		
-					-	-		
-					-	-		
						-		
_					-	-		
-					-	-		
-					-	-		
_ 12.5						-		
-					-	-		
-					-	-		
F					-	-		
Notes:								
			The Galli Group					

					Test Pit No.: TP-9				
PROJ	ECT					PRO	JECT NO	D.	
			3200	Crater I	ake Avenue - Medford	02-6139-01			
CLIEN	IT		200			DATE			
		F	Rogue	e Valley	Transportation District		06/21/2022		
LOCA	LOCATION								
EXO A	See Figure 3, Site Plan with Exploration Locations								
EXCA	VATIC	ON METHC	טט			LOG	GER		
Hitachi ZX120 Excavator with 2-foot wide, rock tooth bucket DEPTH TO - Water: none When checked: 06/21/2022 Cavir							Lyn Ch	and	
		SOIL SYMB	OLS						
ELEVATIO) // (AND SAMPL		USCS	DESCRIPTION	DEN		MOISTURE	
DEPTH		GRAPHIC	DRIVE				рст	%	
Г	- 0		-						
-			-	FILL	Dense, 4-inch minus, crushed rock. (FILL)		-	-	
-				СН	Medium stiff, dark brown, silty, Clay; with sand and trace rounded gravels, moist.	1	-	-	
_					Sample S-1, bag.		-	37.0	
_	- 2.5		-						
-				SC	Medium dense to dense, light brown, clayey Sand; v gravels and cobbles moist to wet	with	-	-	
-		//// ////			Sample S-2, bag.		-	25.3	
-	_	· · /· · /· · /· · /· · /·					-	_	
	- 5		_					_	
-				ROCK	SANDSTONE, light brown, highly weathered to slig	ghtly	-	-	
-					(Payne Cliff Formation).		-	n/a	
-		X///	-		Sample S-3, bag. Bottom of test pit at 7.0'.				
	- 7.5				Minor sidewall seepage observed at 5.5' depth (botto	om of		_	
_					soil/top of rock transition).		-	_	
-							-	-	
-							-	-	
	- 10							_	
_							-	-	
-							-	_	
-							-	_	
_	- 12.5						_	_	
_							-	-	
ŀ							-	_	
	-						-	-	
Notes:									
					The Galli Group				

TEST PIT LOG

		Test Pit No.: TP-10			
PROJECT			PRO	JECT NO).
3200	Crater I	Lake Avenue - Medford		02-6139	9-01
CLIENT			DAT	E	
Rogue	e Valley	Transportation District		06/21/2	022
	~ -		ELE	V.	
See Figure 3, EXCAVATION METHOD	, Site Pl	an with Exploration Locations	LOG	GER	
Hitachi ZX120 Ex	cavator	with 2-foot wide, rock tooth bucket		Lyn Ch	and
DEPTH TO - Water: none	Wh	en checked: 06/21/2022 Caving:	none		
LEVATION/ DEPTH BRAPHIC	USCS	DESCRIPTION		DENSITY pcf	MOISTURI %
	FILI	Dense 4-inch minus crushed rock (FILL)			
	SM	Medium dense, brown, silty, Sand; moist to wet. (F	FILL)	-	-
- 2.5				-	-
	СН	Medium stiff, dark brown, sandy Clay; moist.			
		Sample S-1 hag		-	33.0
- 5		Expansive Clay.		- -	-
				-	-
- 7.5		Stiff to hard, orange brown, clayey, sandy Silt; few cemented gravels, wet. (Decomposed/highly weath Sandstone),	ered	-	-
		Sample S-2, bag.		-	28.1
- 12.5		Bottom of test pit at 11.5'. Minor to moderate seepage observed at 3.0 & 7.5 f (bottom of Sand soil layer & soil/rock transition).	eet		- - - - -
es: Excavation ended in l excavate.	hard so	ils, decomposed to highly weathered Sandsto	one.	Very diff	icult to

APPENDIX B

LABORATORY TEST RESULTS



Atterberg Limits Testing ASTM D4318

Client: Rogue Valley Transportation District Project: Rogue Valley Transportation District Job No. 02-6139-02 Date Sampled: 6/21/2022 Sample Location TP-7/S-2 Depth of Sample: 3.0' - 4.0' Description of Soil: Gray, sandy Clay; with gravels Date Tested: 6/30/2022

Liquid Limit Determination

Can No.	5	3	A-6
Wt. of wet soil + can (g)	18.42	20.48	23.32
Wt. of dry soil + can (g)	15.71	16.63	18.39
Wt. of can (g)	11.58	11.63	11.68
Wt. of dry soil (g)	4.13	5.00	6.71
Wt. of Moisture (g)	2.71	3.85	4.93
Water content, w%	65.6	77.0	73.5
No. of blows, N	39	17	23
it Determination			
Can No	1	M	202

Plastic Limi

Can No.	1	М	202
Wt. of wet soil + can (g)	14.77	15.95	15. 4 5
Wt. of dry soil + can (g)	14.00	14.86	14.51
Wt. of can (g)	11.49	11.85	11.63
Wt. of dry soil (g)	2.51	3.01	2.88
Wt. of Moisture (g)	0.77	1.09	0.94
Water content, w%	30.7	36.2	32.6
LIQUID LIMIT (LL)=	71		
PLASTIC LIMIT (PL)=	32		
PLASTICITY INDEX (PI)=	39		



Tested by: Ken Perry



Atterberg Limits Testing ASTM D4318

Client: Rogue Valley Transportation District Project: Rogue Valley Transportation District Job No. 02-6139-02 Date Sampled: 6/21/2022 Sample Location TP-10/S-1 Depth of Sample: 4.0' - 5.0' Description of Soil: **Dark brown, silty Clay** Date Tested: 6/30/2022

Liquid Limit Determination

Can No.	Z	2	201
Wt. of wet soil + can (g)	20.77	22.98	24.76
Wt. of dry soil + can (g)	17.25	18.54	19.38
Wt. of can (g)	11.54	11.63	11.57
Wt. of dry soil (g)	5.71	6.91	7.81
Wt. of Moisture (g)	3.52	4.44	5.38
Water content, w%	61.6	64.3	68.9
No. of blows, N	33	24	14

Plastic Limit Determination

Can No.	N	I	203
Wt. of wet soil + can (g)	14.87	17.00	20.68
Wt. of dry soil + can (g)	14.18	15.82	19.82
Wt. of can (g)	11.79	11.61	16.66
Wt. of dry soil (g)	2.39	4.21	3.16
Wt. of Moisture (g)	0.69	1.18	0.86
Water content, w%	28.9	28.0	27.2
LIQUID LIMIT (LL)≍	63		
PLASTIC LIMIT (PL)=	28		
PLASTICITY INDEX (PI)=	35		



Tested by: Ken Perry



Atterberg Limits Testing ASTM D4318

Client: Rogue Valley Transportation District Project: Rogue Valley Transportation District Job No. 02-6139-02 Date Sampled: 6/21/2022 Sample Location TP-10/S-2 Depth of Sample: 9.0' -10.0' Description of Soil: **light brown, sandy Silt** Date Tested: 6/30/2022

Liquid Limit Determination

Can No.	Y	8	С
Wt. of wet soil + can (g)	20.11	21.25	22.37
Wt. of dry soil + can (g)	17.86	18.64	19.26
Wt. of can (g)	11.54	11.63	11.57
Wt. of dry soil (g)	6.32	7.01	7.69
Wt. of Moisture (g)	2.25	2.61	3.11
Water content, w%	35.6	37.2	40.4
No. of blows, N	33	24	14

Plastic Limit Determination

Can No.	Z	Х	A-1
Wt. of wet soil + can (g)	17.22	17.41	17.67
Wt. of dry soil + can (g)	16.03	16.12	16.42
Wt. of can (g)	11.79	11.61	11.85
Wt. of dry soil (g)	4.24	4.51	4.57
Wt. of Moisture (g)	1.19	1.29	1.25
Water content, w%	28.1	28.6	27.4
LIQUID LIMIT (LL)=	36		
PLASTIC LIMIT (PL)=	28		

8





Tested by: Ken Perry

Expansion Index Worksheet (ASTM D-4829)



gue Valley Transportation District
gue Valley Transportation District
39-01
2/2022
9-3, S-1
6/2022
rk brown, silty Clay; with gravels

191.6
502.6
310.99
1
4.01
0.007309
93.7
80.5

As prepared for testing:

can no.	D2
wet weight of soil + can (g)	449.76
dry weight of soil + can (g)	404.58
weight of can (g)	129.10
weight of dry soil (g)	275.48
weight of water (g)	45.18
moisture content (% of dry weight)	16.4

After testing:

can no.	G6
wet weight of soil + can (g)	579.05
dry weight of soil + can (g)	457.11
weight of can (g)	190.40
weight of dry soil (g)	266.71
weight of water (g)	121.94
moisture content (% of dry weight)	45.7

Saturation (S):

S=	41
%w:	16.4
γd:	80.5
SG:	2.7
$\overline{S=(SG)(w)\gamma d}/(SG)^{*6}$	δ2. 4)-γd

El₅₀ Calculation:

El ₅₀ =	<u>91</u>
S	41
El _M	99
El _{50=Elm} - (50-Sm)*[(6	5+Elm)/(220-Sm)]

#4 + (dry wt.)	45.42	
#4 - (dry wt.)	1046.64	
% Passing #4 Sieve = 💲		

Tested By: Ken Perry

Expansion Index Worksheet (ASTM D-4829)



Client:	Rogue Valley Transporation District
Project	Rogue valley Transporation District
JOD NO:	02-6139-01
Test Date:	6/22/2022
Sample Location:	TP-4, S-2
Sample Date:	6/15/2022
Description of Soil:	dark gray, sandy Clay

Weight of ring (g):	191.6
Wt. Wet sample in ring(g):	481.0
Sample Wet Weight (g):	289.47
Sample Length (in.):	1
Sample Diameter (in.):	4.01
Volume of sample (ft ³):	0.007309
Sample Unit Wt. (PCF):	87.2
Sample Dry Unit Wt. (PCF):	76.3

As prepared for testing:

can no.	G1
wet weight of soil + can (g)	655.96
dry weight of soil + can (g)	597.42
weight of can (g)	190.38
weight of dry soil (g)	407.04
weight of water (g)	58.54
moisture content (% of dry weight)	14.4

After testing:

can no.	G5
wet weight of soil + can (g)	553.40
dry weight of soil + can (g)	442.38
weight of can (g)	189.25
weight of dry soil (g)	253.13
weight of water (g)	111.02
moisture content (% of dry weight)	43.9

$\begin{tabular}{|c|c|c|c|} \hline Expansion Index measured (Elm): \\ \hline EI_m = \Delta H/H_{orig} * 1000 \\ \hline begin dial & 0.0153 \\ end dial: & 0.0849 \\ \hline EI_m: & 70 \\ \hline \end{tabular}$

Saturation (S):

S=	32
%w:	14.4
γd:	76.3
SG:	2.7
$S=(SG)(w)\gamma d)/(S$	G)*62.4)-γd

El₅₀ Calculation:

El ₅₀ =	<u>57</u>
S	32
El _M	70
El _{50=Elm - (50-Sm)*[(65}	+Elm)/(220-Sm)]

#4 + (dry wt.)	7.5
#4 - (dry wt.)	1852.71
% Passi	ng #4 Sieve = 99.6

Tested By Ken Perry



Washed Sieve Analysis (ASTM-D1140)

612 Northwest Third Street, Grants Pass, Oregon 97526

Client: Rogue Valley transportation District Project: Rogue Valley transportation District Job No: 02-6139-01 Date Tested: 6/22/2022 Method of Test: ASTM-D 1140 Date Sampled: 6/21/2022 Description of Soil: brown, silty Sand; with some gravel

Sample Location: B-5/S-1 Depth of Sample: 2.5' - 3.0' Weight of Oven Dry Sample (g): 338.46 Wt after wash (#200): 237.23 Loss to wash: 101.23

Sieve No.	Sieve opening (mm)	Weight retained on each sieve (g)	Percent of weight retained on each sieve	Cumulative percent retained	Percent finer
		0.0			100.0
		0.0			100.0
3/4"	19.00	0.0			100.0
3/8"	9.51	7.5	2.2	2.2	97.8
#4	4.76	21.7	6.4	8.6	91.4
#10	2.000	16.4	4.8	13.4	86.6
#40	0.420	106.8	31.6	45.0	55.0
#60	0.250	31.9	9.4	54.4	45.6
#100	0.149	24.5	7.2	61.7	38.3
#200	0.074	24.1	7.1	68.8	31.2
Pan		3.4	1.0	69.8	
Loss to wash		101.2	29.9	99.7	

 $= W_1$ 236.25 Σ =

Loss during sieve analysis =

 $(W - W_1) / W \times 100 = 0.29 \%$



Washed Sieve Analysis (ASTM-D1140)

Client: Rogue Valley transportation District Project: Rogue Valley transportation District Job No: 02-6139-01 Date Tested: 6/22/2022 Method of Test: ASTM-D 1140 Date Sampled: 6/21/2022 Description of Soil: brown, silty Sand; with some gravel Sample Location: B-5/S-1 Depth of Sample: 2.5' - 3.0'



Tested by: Nathan Galli


612 Northwest Third Street, Grants Pass, Oregon 97526

Client:	Rogue Valley Transporation District
Project:	Rogue Valley Transporation District
Job No:	02-6139-01
Date Tested:	6/22/2022
Method of Test:	ASTM-D 1140
Date Sampled:	6/21/2022
Description of Soil:	brown, clayey Sand; with gravel

Sample Location: TP-5/S-1 Depth of Sample: 1.5' - 2.0'

Weight of Oven Dry Sample (g):	1175.81
Wt after wash (#200):	775.16
Loss to wash:	400.65

Sieve No.	Sieve opening (mm)	Weight retained on each sieve (g)	Percent of weight retained on each sieve	Cumulative percent retained	Percent finer
		0.0			100.0
		0.0			100.0
3/4"	19.00	0.0			100.0
3/8"	9.51	80.1	6.8	6.8	93.2
#4	4.76	56.2	4.8	11.6	88.4
#10	2.000	69.3	5.9	17.5	82.5
#40	0.420	322.7	27.4	44.9	55.1
#60	0.250	100.1	8.5	53.5	46.5
#100	0.149	73.0	6.2	59.7	40.3
#200	0.074	65.0	5.5	65.2	34.8
Pan		9.4	0.8	66.0	
Loss to wash		400.7	34.1	100.1	

Σ = 775.91 **=** W₁

Loss during sieve analysis =

 $(W - W_1) / W \times 100 = -0.06$ %



Client: Rogue Valley Transporation District Project: Rogue Valley Transporation District Job No: 02-6139-01 Date Tested: 6/22/2022 Method of Test: ASTM-D 1140 Date Sampled: 6/21/2022 Description of Soil: brown, clayey Sand; with gravel Sample Location: TP-5/S-1 Depth of Sample: 1.5' - 2.0'



Tested by: Ken Perry



612 Northwest Third Street, Grants Pass, Oregon 97526

Client: Rogue Valley Transportation District Project: Rogue Valley Transportation District Job No: 02-6139-01 Date Tested: 6/22/2022 Method of Test: ASTM-D1140 Date Sampled: 6/21/2022 Description of Soil: brown, clayey Gravel; with sand

Sample Location: TP-7/S-3 Depth of Sample: 9.0' - 10.0' Weight of Oven Dry Sample (g): 1320.21 Wt after wash (#200): 767.86 Loss to wash: 552.35

Sieve No.	Sieve opening (mm)	Weight retained on each sieve (g)	Percent of weight retained on each sieve	Cumulative percent retained	Percent finer
		0.0			100.0
		0.0			100.0
3/4"	19.00	206.5	15.6	15.6	84.4
3/8"	9.51	195.1	14.8	30.4	69.6
#4	4.76	118.3	9.0	39.4	60.6
#10	2.000	74.5	5.6	45.0	55.0
#40	0.420	81.3	6.2	51.2	48.8
#60	0.250	20.8	1.6	52.8	47.2
#100	0.149	21.0	1.6	54.4	45.6
#200	0.074	43.7	3.3	57.7	42.3
Pan		7.9	0.6	58.3	
Loss to wash		552.4	41.8	100.1	

= W₁ Σ = 769.18

Loss during sieve analysis =

 $(W - W_1) / W \times 100 = -0.10$ %



Client: Rogue Valley Transportation District Project: Rogue Valley Transportation District Job No: 02-6139-01 Date Tested: 6/22/2022 Method of Test: ASTM-D1140 Date Sampled: 6/21/2022 Description of Soil: brown, clayey Gravel; with sand Sample Location: TP-7/S-3 Depth of Sample: 9.0' - 10.0'



Tested by: Nathan Galli



Washed Sieve and Hydrometer Analysis (ASTM D1140 and ASTM D7928)

612 Northwest Third Street, Grants Pass, Oregon 97526

> Client: Rogue Valley Transportation District Project: Rogue Valley Transportation District Job No: 02-6139-01 Date Tested: 7/7/2022 Date Sampled: 6/22/2022 Description of Soil: gray/brown, sandy Clay;with silt, trace gravel and orgaincs

 Weight of Oven Dry Sample (g):
 420.16

 Wt after wash (#200):
 105.90

 Loss to wash:
 314.26

Boring No / Sample No:	TP-8, S-2
Depth of Sample:	3.0' - 3.5'

Sieve No.	Sieve opening (mm)	Weight retained on each sieve (g)	Percent of weight retained on each sieve	Cumulative percent retained	Percent finer
		0.0			100.0
3/4"	19	0.0			100.0
3/8"	9.51	2.6	0.6	0.6	99.4
#4	4.76	3.2	0.8	1.4	98.6
#10	2.000	0.5	0.1	1.5	98.5
#40	0.420	49.3	11.7	13.2	86.8
#60	0.250	22.8	5.4	18.7	81.3
#100	0.149	16.7	4.0	22.6	77.4
#200	0.074	9.3	2.2	24.8	75.2
Pan		0.6	0.1	25.0	
Loss to wash		314.3	74.8	99.8	

$$\Sigma = 419.25 = W_1$$

Loss during sieve analysis =

 $(W - W_1) / W \times 100 = 0.22$

%



Washed Sieve and Hydrometer Analysis (ASTM D1140 and ASTM D7928)

Client: Rogue Valley Transportation District Project: Rogue Valley Transportation District Job No: 02-6139-01 Date Tested: 7/7/2022 Date Sampled: 6/22/2022 Description of Soil: gray/brown, sandy Clay;with silt, trace gravel and orgaincs Boring No / Sample No: TP-8, S-2 Depth of Sample: 3.0' - 3.5'



Tested by: Nate Galli



Washed Sieve and Hydrometer Analysis (ASTM D1140 and ASTM D7928)

612 Northwest Third Street, Grants Pass, Oregon 97526

> Client: Rogue Valley Transportation District Project: Rogue Valley Transportation District Job No: 02-6139-01 Date Tested: 7/7/2022 Date Sampled: 6/22/2022 Description of Soil: brown Clay: with sand and silt

Boring No / Sample No: TP-9, S-1

Depth of Sample: 2.0' - 2.5'

Weight of Oven Dry Sample (g):	376.11
Wt after wash (#200):	51.48
Loss to wash:	324.63

Sieve No.	Sieve opening (mm)	Weight retained on each sieve (g)	Percent of weight retained on each sieve	Cumulative percent retained	Percent finer
		0.0			100.0
3/4"	19	0.0			100.0
3/8"	9.51	0.0			100.0
#4	4.76	1.1	0.3	0.3	99.7
#10	2.000	0.7	0.2	0.5	99.5
#40	0.420	22.1	5.9	6.3	93.7
#60	0.250	12.1	3.2	9.5	90.5
#100	0.149	10.3	2.7	12.3	87.7
#200	0.074	6.2	1.6	13.9	86.1
Pan		0.6	0.1	14.1	
Loss to wash		324.6	86.3	100.4	

Loss during sieve analysis =

(W - W₁) / W X 100 = -0.38

%



Washed Sieve and Hydrometer Analysis (ASTM D1140 and ASTM D7928)

Client: Rogue Valley Transportation District Project: Rogue Valley Transportation District Job No: 02-6139-01 Date Tested: 7/7/2022 Date Sampled: 6/22/2022 Description of Soil: brown Clay: with sand and silt Boring No / Sample No: TP-9, S-1 Depth of Sample: 2.0' - 2.5'



Tested by: Nate Galli



612 Northwest Third Street, Grants Pass, Oregon 97526

Client: Rogue Valley Transportation District Project: Rogue Valley Transportation District Job No: 02-6139-01 Date Tested: 6/22/2022 Method of Test: ASTM D1140 Date Sampled: 6/21/2022 Description of Soil: gray, sandy Clay; with some gravel

Sample Location: TP-10/S-1 Depth of Sample: 4.0' - 5.0' Weight of Oven Dry Sample (g): 1214.55 Wt after wash (#200): 389.17 Loss to wash: 825.38

%

Sieve No.	Sieve opening (mm)	Weight retained on each sieve (g)	Percent of weight retained on each sieve	Cumulative percent retained	Percent finer
		0.0			100.0
		0.0			100.0
3/4"	19.00	29.6	2.4	2.4	97.6
3/8"	9.51	38.0	3.1	5.6	94.4
#4	4.76	37.1	3.1	8.6	91.4
#10	2.000	46.9	3.9	12.5	87.5
#40	0.420	126.2	10.4	22.9	77.1
#60	0.250	46.5	3.8	26.7	73.3
#100	0.149	33.2	2.7	29.4	70.6
#200	0.074	28.0	2.3	31.7	68.3
Pan		2.0	0.2	31.9	
Loss to wash		825.4	68.0	99.9	

Σ = **387.47** = W₁

Loss during sieve analysis =

 $(W - W_1) / W \times 100 = 0.14$



Client: Rogue Valley Transportation District Project: Rogue Valley Transportation District Job No: 02-6139-01 Date Tested: 6/22/2022 Method of Test: ASTM D1140 Date Sampled: 6/21/2022 Description of Soil: gray, sandy Clay; with some gravel Sample Location: TP-10/S-1 Depth of Sample: 4.0' - 5.0'



Tested by: Nathan Galli



Washed Sieve and Hydrometer Analysis (ASTM D1140 and ASTM D7928)

612 Northwest Third Street, Grants Pass, Oregon 97526

> Client: Rogue Valley Transportation District Project: Rogue Valley Transportation District Job No: 02-6139-01 Date Tested: 7/7/2022 Date Sampled: 6/22/2022 Description of Soil: light brown, clayey,sandy Silt

Boring No / Sample No: TP-10, S-2 Depth of Sample: 9.0' - 10.0'

Weight of Oven Dry Sample (g):	486.59
Wt after wash (#200):	209.84
Loss to wash:	276.75

Sieve No.	Sieve opening (mm)	Weight retained on each sieve (g)	Percent of weight retained on each sieve	Cumulative percent retained	Percent finer
		0.0			100.0
3/4"	19	0.0			100.0
3/8"	9.51	0.0			100.0
#4	4.76	0.9	0.2	0.2	99.8
#10	2.000	0.1	0.0	0.2	99.8
#40	0.420	45.8	9.4	9.6	90.4
#60	0.250	63.0	12.9	22.6	77.4
#100	0.149	61.6	12.7	35.2	64.8
#200	0.074	32.6	6.7	41.9	58.1
Pan		4.4	0.9	42.8	
Loss to wash		276.8	56.9	99.7	

Loss during sieve analysis =

 $(W - W_1) / W X 100 = 0.29$

%



Washed Sieve and Hydrometer Analysis (ASTM D1140 and ASTM D7928)

Client: Rogue Valley Transportation District Project: Rogue Valley Transportation District Job No: 02-6139-01 Date Tested: 7/7/2022 Date Sampled: 6/22/2022 Description of Soil: light brown, clayey,sandy Silt Boring No / Sample No: TP-10, S-2 Depth of Sample: 9.0' - 10.0'



Tested by: Nate Galli