PROJECT MANUAL

SPARTANBURG Community College

TYGER RIVER BUILDING COSMETOLOGY RENOVATION

DUNCAN, SOUTH CAROLINA

ARCHITECT'S PROJECT NO.: 635251
OSE PROJECT NO.: H59-N306-JM

MOSELEYARCHITECTS

ARCHITECT/ENGINEER — CHARLOTTE, NORTH CAROLINA

PERMIT SET

April 08, 2025

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PROJECT NUMBER: H59-N306-JM

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SE-310
INVITATION FOR DESIGN-BID-BUILD CONSTRUCTION SERVICES

AGENCY: SCC - Spartanburg Community College

PROJECT NAME: SCC - Tyger River Building Cosmetology Renovation

PROJECT NUMBER: H59-N306-JM **CONSTRUCTION COST RANGE:** $1,000,000 **to** $1,250,000

PROJECT LOCATION: 1875 East Main Street, Duncan, SC 29334

DESCRIPTION OF PROJECT/SERVICES: *(450 character limit)*

Renovation of approximately 14,000SF with limited space reconfiguration for cosmetology to include 40 styling stations, 4 hair washing stations, manicure stations, pedicure stations and two academic classrooms. In addition, the Project includes the renovation of upper level restrooms, new finishes, lighting, and HVAC throughout the second floor.

BID/SUBMITTAL DUE DATE: 06/03/2025 **TIME:** 10:00 AM **NUMBER OF COPIES:** 1

PROJECT DELIVERY METHOD: Design-Bid-Build

AGENCY PROJECT COORDINATOR: Patrick Kennedy

EMAIL: kennedyp@sccsc.edu **TELEPHONE:** (864) 640-1651

DOCUMENTS OBTAINED FROM: https://www.sccsc.edu/about/vendors/construction-solicitations/

BID SECURITY IS REQUIRED IN AN AMOUNT NOT LESS THAN 5% OF THE BASE BID.
PERFORMANCE AND LABOR & MATERIAL PAYMENT BONDS: The successful Contractor will be required to provide Performance and Labor and Material Payment Bonds, each in the amount of 100% of the Contract Price.

DOCUMENT DEPOSIT AMOUNT: $0.00 **IS DEPOSIT REFUNDABLE:** ○ **Yes** ○ **No** ● **N/A**

Bidders must obtain Bidding Documents/Plans from the above listed sources(s) to be listed as an official plan holder. Bidders that rely on copies obtained from any other source do so at their own risk. All written communications with official plan holders & bidders will be via email or website posting.

Agency **WILL NOT** accept Bids sent via email.

All questions & correspondence concerning this Invitation shall be addressed to the A/E.

A/E NAME: Moseley Architects **A/E CONTACT:** Shannon Calloway

EMAIL: scalloway@moselyarchitecture.com **TELEPHONE:** (864) 720-1674

PRE-BID CONFERENCE: ● **Yes** ○ **No** **MANDATORY ATTENDANCE:** ○ **Yes** ● **No**

PRE-BID DATE: 05/13/2025 **TIME:** 02:00 PM

PRE-BID PLACE: 1875 E Main Street, Duncan SC 29334

BID OPENING PLACE: Spartanburg Community College - 103 Community College Drive, Rm 237, Spartanburg SC 29303

BID DELIVERY ADDRESSES:

HAND-DELIVERY:

Attn: Sheri Johnson (Bid Enclosed)
103 Community College Drive, Room 240
Spartanburg SC 29303

MAIL SERVICE:

Attn: Sheri Johnson (Bid Enclosed)
131 Community College Drive
Spartanburg SC 29303

IS PROJECT WITHIN AGENCY CONSTRUCTION CERTIFICATION? ○ **Yes** ● **No**

APPROVED BY: James R. McVay Jr. **DATE:** 05/01/2025

(OSE PROJECT MANAGER)

South Carolina Division of Procurement Services, Office of State Engineer Version of AIA® Document A701™ – 2018

Instructions to Bidders

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South Carolina Division of Procurement Services, Office of State Engineer Version of AIA® Document A701™ – 2018

Instructions to Bidders

for the following Project:
(Name, State Project Number, location, and detailed description)
Tyger River Building Cosmetology Renovation
H59-N306-JM
1875 E. Main Street, Duncan, SC 29334

THE OWNER:
(Name, legal status, address, and other information)
Spartanburg Community College
131 Community College Drive
Spartanburg, SC 29303

The Owner is a Governmental Body of the State of South Carolina as defined by S.C. Code Ann. § 11-35-310.

THE ARCHITECT:
(Name, legal status, address, and other information)
Moseley Architects P.C.
6210 Ardrey Kell Road, The Hub at Waverly, Suite 425
Charlotte, NC 28277

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

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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.

§ 1.1.1 Any reference in this document to the Agreement between the Owner and Contractor, AIA Document A101, or some abbreviated reference thereof, shall mean the AIA Document A101-2017 Standard Form of Agreement Between Owner and Contractor, SCOSE Version. Any reference in this document to the General Conditions of the Contract for Construction, AIA Document A201, or some abbreviated reference thereof, shall mean the AIA Document A201-2017 General Conditions of the Contract for Construction, SCOSE Version.

§ 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.

§ 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:

- **.1** the Bidder has read and understands the Bidding Documents;
- **.2** the Bidder understands how the Bidding Documents relate to other portions of the Project, if any, being bid 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, has correlated the Bidder's observations with the requirements of the Proposed Contract Documents, and accepts full responsibility for any pre-bid existing conditions that would affect the Bid that could have been ascertained by a site visit. As provided in S.C. Code Ann. Reg. 19-445.2042(B), a bidder's failure to attend an advertised pre-bid conference will not excuse its responsibility for estimating properly the difficulty and cost of successfully performing the work, or for proceeding to successfully perform the work without additional expense to the State;
- **.5** the Bid is based upon the materials, equipment, and systems required by the Bidding Documents without exception;
- **.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; and
- **.7** the Bidder understands that it may be required to accept payment by electronic funds transfer (EFT).

§ 2.2 Certification of Independent Price Determination

§ 2.2.1 GIVING FALSE, MISLEADING, OR INCOMPLETE INFORMATION ON THIS CERTIFICATION MAY RENDER YOU SUBJECT TO PROSECUTION UNDER SC CODE OF LAWS §16-9-10 AND OTHER APPLICABLE LAWS.

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§ 2.2.2 By submitting a Bid, the Bidder certifies that:

.1 The prices in this Bid have been arrived at independently, without, for the purpose of restricting competition, any consultation, communication, or agreement with any other bidder or competitor relating to:

.1 those prices;
.2 the intention to submit a Bid; or
.3 the methods or factors used to calculate the prices offered.

.2 The prices in this Bid have not been and will not be knowingly disclosed by the Bidder, directly or indirectly, to any other bidder or competitor before bid opening (in the case of a sealed bid solicitation) or contract award (in the case of a negotiated solicitation) unless otherwise required by law; and

.3 No attempt has been made or will be made by the Bidder to induce any other concern to submit or not to submit a Bid for the purpose of restricting competition.

§ 2.2.3 Each signature on the Bid is considered to be a certification by the signatory that the signatory:

.1 Is the person in the Bidder's organization responsible for determining the prices being offered in this Bid, and that the signatory has not participated and will not participate in any action contrary to Section 2.2.2 of this certification; or

.2 Has been authorized, in writing, to act as agent for the Bidder's principals in certifying that those principals have not participated, and will not participate in any action contrary to Section 2.2.2 of this certification [As used in this subdivision, the term "principals" means the person(s) in the Bidder's organization responsible for determining the prices offered in this Bid];

.3 As an authorized agent, does certify that the principals referenced in Section 2.2.3.2 of this certification have not participated, and will not participate, in any action contrary to Section 2.2.2 of this certification; and

.4 As an agent, has not personally participated, and will not participate, in any action contrary to Section 2.2.2 of this certification.

§ 2.2.4 If the Bidder deletes or modifies Section 2.2.2.2 of this certification, the Bidder must furnish with its offer a signed statement setting forth in detail the circumstances of the disclosure.

§ 2.2.5 Drug Free Workplace Certification

By submitting a Bid, the Bidder certifies that, if awarded a contract, Bidder will comply with all applicable provisions of The Drug-free Workplace Act, S.C. Code Ann. 44-107-10, et seq.

§ 2.2.6 Certification Regarding Debarment and Other Responsibility Matters

§ 2.2.6.1 By submitting a Bid, Bidder certifies, to the best of its knowledge and belief, that:

.1 Bidder and/or any of its Principals-

.1 Are not presently debarred, suspended, proposed for debarment, or declared ineligible for the award of contracts by any state or federal agency;

.2 Have not, within a three-year period preceding this Bid, 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) contract or subcontract; violation of Federal or state antitrust statutes relating to the submission of bids; or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, tax evasion, or receiving stolen property; and

.3 Are not presently indicted for, or otherwise criminally or civilly charged by a governmental entity with, commission of any of the offenses enumerated in Section 2.2.6.1.1.2 of this provision.

.2 Bidder has not, within a three-year period preceding this Bid, had one or more contracts terminated for default by any public (Federal, state, or local) entity.

.3 "Principals," for the purposes of this certification, means officers; directors; owners; partners; and, persons having primary management or supervisory responsibilities within a business entity (e.g., general manager; plant manager; head of a subsidiary, division, or business segment, and similar positions).

§ 2.2.6.2 Bidder shall provide immediate written notice to the Procurement Officer if, at any time prior to contract award, Bidder learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

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§ 2.2.6.3 If Bidder is unable to certify the representations stated in Section 2.2.6.1, Bidder must submit a written explanation regarding its inability to make the certification. The certification will be considered in connection with a review of the Bidder's responsibility. Failure of the Bidder to furnish additional information as requested by the Procurement Officer may render the Bidder non-responsible.

§ 2.2.6.4 Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render, in good faith, the certification required by Section 2.2.6.1 of this provision. The knowledge and information of a Bidder is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

§ 2.2.6.5 The certification in Section 2.2.6.1 of this provision is a material representation of fact upon which reliance was placed when making award. If it is later determined that the Bidder knowingly or in bad faith rendered an erroneous certification, in addition to other remedies available to the State, the Procurement Officer may terminate the contract resulting from this solicitation for default.

§ 2.2.7 Ethics Certificate

By submitting a Bid, the Bidder certifies that the Bidder has and will comply with, and has not, and will not, induce a person to violate Title 8, Chapter 13 of the SC Code of Laws, as amended (Ethics Act). The following statutes require special attention: S.C. Code Ann. §8-13-700, regarding use of official position for financial gain; S.C. Code Ann. §8-13-705, regarding gifts to influence action of public official; S.C. Code Ann. §8-13-720, regarding offering money for advice or assistance of public official; S.C. Code Ann. §8-13-755 and §8-13-760, regarding restrictions on employment by former public official; S.C. Code Ann. §8-13-775, prohibiting public official with economic interests from acting on contracts; S.C. Code Ann. §8-13-790, regarding recovery of kickbacks; S.C. Code Ann. §8-13-1150, regarding statements to be filed by consultants; and S.C. Code Ann. §8-13-1342, regarding restrictions on contributions by contractor to candidate who participated in awarding of contract. The State may rescind any contract and recover all amounts expended as a result of any action taken in violation of this provision. If the contractor participates, directly or indirectly, in the evaluation or award of public contracts, including without limitation, change orders or task orders regarding a public contract, the contractor shall, if required by law to file such a statement, provide the statement required by S.C. Code Ann. §8-13-1150 to the Procurement Officer at the same time the law requires the statement to be filed.

§ 2.2.8 Restrictions Applicable To Bidders & Gifts

Violation of these restrictions may result in disqualification of your Bid, suspension or debarment, and may constitute a violation of the state Ethics Act.

§ 2.2.8.1 After issuance of the solicitation, Bidder agrees not to discuss this procurement activity in any way with the Owner or its employees, agents or officials. All communications must be solely with the Procurement Officer. This restriction may be lifted by express written permission from the Procurement Officer. This restriction expires once a contract has been formed.

§ 2.2.8.2 Unless otherwise approved in writing by the Procurement Officer, Bidder agrees not to give anything to the Owner, any affiliated organizations, or the employees, agents or officials of either, prior to award.

§ 2.2.8.3 Bidder acknowledges that the policy of the State is that a governmental body should not accept or solicit a gift, directly or indirectly, from a donor if the governmental body has reason to believe the donor has or is seeking to obtain contractual or other business or financial relationships with the governmental body. SC Regulation 19-445.2165(C) broadly defines the term donor.

§ 2.2.9 Open Trade Representation

By submitting a Bid, the Bidder represents that Bidder is not currently engaged in the boycott of a person or an entity based in or doing business with a jurisdiction with whom South Carolina can enjoy open trade, as defined in S.C. Code Ann. §11-35-5300.

ARTICLE 3 BIDDING DOCUMENTS

§ 3.1 Distribution

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

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§ 3.1.2 Any required deposit shall be refunded to all plan holders who return the paper Bidding Documents in good condition within ten (10) 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 Reserved

§ 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.

§ 3.1.6 All persons obtaining Bidding Documents from the issuing office designated in the advertisement shall provide that office with Bidder's contact information to include the Bidder's name, telephone number, mailing address, and email address.

§ 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. Failure to do so will be at the Bidder's risk. Bidder assumes responsibility for any patent ambiguity that Bidder does not bring to the Architect's attention prior to Bid Opening.

§ 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 ten (10) days prior to the date for receipt of Bids.

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

§ 3.2.4 As provided in S.C. Code Ann. Reg. 19-445.2042(B), nothing stated at the Pre-bid conference shall change the Bidding Documents unless a change is made by Addendum.

§ 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. Where "brand name or equal" is used in the Bidding Documents, the listing description is not intended to limit or restrict competition.

§ 3.3.2 Substitution Process

§ 3.3.2.1 Written requests for substitutions shall be received by the Architect at least ten (10) 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.

§ 3.3.2.4 No request to substitute materials, products, or equipment for materials, products, or equipment described in the Bidding Documents and no request for addition of a manufacturer or supplier to a list of approved manufacturers or suppliers in the Bidding Documents will be considered prior to receipt of Bids unless written request for approval has been received by the Architect at least ten (10) days prior to the date for receipt of Bids established in the invitation to bid.

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Any subsequent extension of the date for receipt of Bids by addendum shall not extend the date for receipt of such requests unless the addendum so specifies. A statement setting forth changes in other materials, equipment or other portions of the Work, including changes in the Work of other contracts that incorporation of the proposed substitution would require, shall be included.

§ 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.

§ 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.

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

§ 3.4.3 Addenda will be issued at least five (5) business days before the day of the Bid Opening, except an Addendum withdrawing the request for Bids or one which includes postponement of the date for receipt of Bids. A business day runs from midnight to midnight and excludes weekends and state and federal holidays.

§ 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.

§ 3.4.5 When the date for receipt of Bids is to be postponed and there is insufficient time to issue an Addendum prior to the original Bid Date, the Owner will notify prospective Bidders by telephone or other appropriate means with immediate follow up with an Addendum. This Addendum will verify the postponement of the original Bid Date and establish a new Bid Date. The new Bid Date will be no earlier than the fifth (5th) business day after the date of issuance of the Addendum postponing the original Bid Date.

§ 3.4.6 If an emergency or unanticipated event interrupts normal government processes so that Bids cannot be received at the government office designated for receipt of Bids by the exact time specified in the solicitation, the time specified for receipt of Bids will be deemed to be extended to the same time of day specified in the solicitation on the first work day on which normal government processes resume. In lieu of an automatic extension, an Addendum may be issued to reschedule Bid Opening. If state offices are closed in the county in which Bids are to be received at the time a pre-bid or pre-proposal conference is scheduled, an Addendum will be issued to reschedule the conference. Bidders shall visit https://www.scemd.org/closings/ for information concerning closings.

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.

§ 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 numbers.

§ 4.1.4 Interlineations, alterations and erasures must be initialed by the signer of the Bid. Bidder shall not make stipulations or qualify his Bid in any manner not permitted on the Bid Form. An incomplete Bid or information not requested that is written on or attached to the Bid Form that could be considered a qualification of the Bid, may be cause for rejection of the Bid.

§ 4.1.5 All requested Alternates shall be bid. The failure of the Bidder to indicate a price for an Alternate shall render the Bid non-responsive. Indicate the change to the Base Bid by entering the dollar amount and marking, as appropriate, the box for "ADD TO" or "DEDUCT FROM". If no change in the Base Bid is required, enter "ZERO" or "No Change".

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§ 4.1.6 Pursuant to S.C. Code Ann. § 11-35-3020(b)(i), as amended, Section 7 of the Bid Form sets forth a list of proposed subcontractors for which the Bidder is required to identify those subcontractors the Bidder will use to perform the work listed. Bidder must follow the instructions in the Bid Form for filling out this section of the Bid Form. Failure to properly fill out Section 7 may result in rejection of Bidder's bid as non-responsive.

§ 4.1.7 Contractors and subcontractors listed in Section 7 of the Bid Form who are required by the South Carolina Code of Laws to be licensed, must be licensed as required by law at the time of bidding.

§ 4.1.8 Each copy of the Bid shall state the legal name and legal status of the Bidder. Each copy of the Bid shall be signed by the person or persons legally authorized to bind the Bidder to a contract.

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

§ 4.2 Bid Security

§ 4.2.1 If required by the invitation to bid, each Bid shall be accompanied by a bid security in an amount of not less than five percent of the Base Bid. The bid security shall be a bid bond or a certified cashier's check.

§ 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.

§ 4.2.3 If a surety bond is required as bid security, it shall be written on AIA Document A310™, Bid Bond and 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 Bid Bond shall:

.1 be issued by a surety company licensed to do business in South Carolina;

.2 be issued by a surety company having, at a minimum, a "Best Rating" of "A" as stated in the most current publication of "Best's Key Rating Guide, Property-Casualty", which company shows a financial strength rating of at least five (5) times the contract price.

.3 be enclosed in the bid envelope at the time of Bid Opening, either in paper copy or as an electronic bid bond authorization number provided on the Bid Form and issued by a firm or organization authorized by the surety to receive, authenticate and issue binding electronic bid bonds on behalf the surety.

§ 4.2.4 The Owner will have the right to retain the bid security of Bidders to whom an award is being considered until either (a) the Contract has been executed and performance and payment 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.

§ 4.2.5 By submitting a Bid Bond via an electronic bid bond authorization number on the Bid Form and signing the Bid Form, the Bidder certifies that an electronic bid bond has been executed by a Surety meeting the standards required by the Bidding Documents and the Bidder and Surety are firmly bound unto the State of South Carolina under the conditions provided in this Section 4.2.

§ 4.3 Submission of Bids

§ 4.3.1 A Bidder shall submit its Bid as indicated below:

§ 4.3.2 All 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, unless hand delivered by the Bidder, be addressed to the Owner's designated purchasing office as shown in the invitation to bid. The envelope 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, or special delivery service (UPS, Federal Express, etc.), the sealed envelope shall be labelled "SEALED BID ENCLOSED" on the face thereof. Bidders hand delivering their Bids shall deliver Bids to the place of the Bid Opening as shown in the invitation for bids. Whether or not Bidders attend the Bid Opening, they shall give their Bids to the Owner's Procurement Officer or his/her designee as shown in the invitation to bid prior to the time of the Bid Opening.

§ 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.

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§ 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. Oral, telephonic, telegraphic, facsimile or other electronically transmitted bids will not be considered.

§ 4.3.6 The official time for receipt of Bids will be determined by reference to the clock designated by the Owner's Procurement Officer or his/her designee. The Procurement Officer conducting the Bid Opening will determine and announce that the deadline has arrived and no further Bids or bid modifications will be accepted. All Bids and bid modifications in the possession of the Procurement Officer at the time the announcement is completed will be timely, whether or not the bid envelope has been date/time stamped or otherwise marked by the Procurement Officer.

§ 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.

ARTICLE 5 CONSIDERATION OF BIDS

§ 5.1 Opening of Bids

Bids received on time will be publicly opened and read aloud. The Owner will not read aloud Bids that the Owner determines, at the time of opening, to be non-responsive.

§ 5.1.1 At Bid Opening, the Owner will announce the date and location of the posting of the Notice of Intend to Award. If the Owner determines to award the Project, the Owner will, after posting a Notice of Intend to Award, send a copy of the Notice to all Bidders.

§ 5.1.2 The Owner will send a copy of the final Bid Tabulation to all Bidders within ten (10) working days of the Bid Opening.

§ 5.1.3 If only one Bid is received, the Owner will open and consider the Bid.

§ 5.2 Rejection of Bids

§ 5.2.1 The Owner shall have the right to reject any or all Bids. A Bid not accompanied by a required bid security or by other data required by the Bidding Documents, or a Bid which is in any way incomplete or irregular is subject to rejection.

§ 5.2.2 The reasons for which the Owner will reject Bids include, but are not limited to:

- **.1** Failure by a Bidder to be represented at a Mandatory Pre-Bid Conference or site visit;
- **.2** Failure to deliver the Bid on time;
- **.3** Failure to comply with Bid Security requirements, except as expressly allowed by law;
- **.4** Listing an invalid electronic Bid Bond authorization number on the Bid Form;
- **.5** Failure to Bid an Alternate, except as expressly allowed by law;
- **.6** Failure to list qualified subcontractors as required by law;
- **.7** Showing any material modification(s) or exception(s) qualifying the Bid;
- **.8** Faxing a Bid directly to the Owner or Owner's representative; or
- **.9** Failure to include a properly executed Power-of-Attorney with the Bid Bond.

§ 5.2.3 The Owner may reject a Bid as nonresponsive if the prices bid are materially unbalanced between line items or sub-line items. A Bid is materially unbalanced when it is based on prices significantly less than cost for some work and prices which are significantly overstated in relation to cost for other work, and if there is a reasonable doubt that the Bid

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will result in the lowest overall cost to the Owner even though it may be the low evaluated Bid, or if it is so unbalanced as to be tantamount to allowing an advance payment.

§ 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 and does not exceed available funds. 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 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.

ARTICLE 6 POST-BID INFORMATION

§ 6.1 Contractor's Responsibility

Owner will make a determination of Bidder's responsibility before awarding a contract. Bidder shall provide all information and documentation requested by the Owner to support the Owner's evaluation of responsibility. Failure of Bidder to provide requested information is cause for the Owner, at its option, to determine the Bidder to be non-responsible.

§ 6.2 Reserved

§ 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:

.1 a designation of the Work to be performed with the Bidder's own forces;

.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.

§ 6.4 Posting of Intent To Award

The Notice of Intent to Award will be posted at the following location:

Room or Area of Posting: Lobby
Building Where Posted: Campus Operations Building
Address of Building: 136 Community College Dr., Spartanburg, SC 29303
WEB site address (if applicable): Not Applicable
Posting date will be announced at Bid Opening. In addition to posting the Notice, the Owner will promptly send all responsive Bidders a copy of the Notice of Intent to Award and the final bid tabulation

§ 6.5 Protest of Solicitation or Award

§ 6.5.1 If you are aggrieved in connection with the solicitation or award of a contract, you may be entitled to protest, but only as provided in S.C. Code Ann. § 11-35-4210. To protest a solicitation, you must submit a protest within fifteen (15) days of the date the applicable solicitation document is issued. To protest an award, you must (i) submit notice if your intent to protest within seven (7) business days of the date the award notice is posted, and (ii) submit your actual protest within fifteen (15) days of the date the award notice is posted. Days are calculated as provided in Section 11-35-310(13). Both protests and notices of intent to protest must be in writing and must be received by the State Engineer within the time provided. The grounds of the protest and the relief requested must be set forth with enough particularity to give notice of the issues to be decided.

§ 6.5.2 Any protest must be addressed to the CPO, Office of State Engineer, and submitted in writing:

.1 by email to protest-ose@mmo.sc.gov,

.2 by facsimile at 803-737-0639, or

.3 by post or delivery to 1201 Main Street, Suite 600, Columbia, SC 29201.

By submitting a protest to the foregoing email address, you (and any person acting on your behalf) consent to receive communications regarding your protest (and any related protests) at the e-mail address from which you sent your protest.

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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.

§ 7.1.3 The Bidder shall provide surety bonds from a company or companies lawfully authorized to issue surety bonds in the state of South Carolina.

§ 7.1.4 Unless otherwise indicated below, the Penal Sum of the Payment and Performance Bonds shall be the amount of 100% of the Contract Sum.

§ 7.2 Time of Delivery of Contract, Certificates of Insurance, and Form of Bonds

§ 7.2.1 Following expiration of the protest period, the Owner will forward the Contract for Construction to the Bidder for signature. The Bidder shall return the fully executed Contract for Construction to the Owner within seven (7) days. The Bidder shall deliver the required bonds and certificate of insurance to the Owner not later than three (3) days following the date of execution of the Contract. Failure to deliver these documents as required shall entitle the Owner to consider the Bidder's failure as a refusal to enter into a contract in accordance with the terms and conditions of the Bidder's Bid and to make claim on the Bid Security for re-procurement cost.

§ 7.2.2 Unless otherwise provided, the bonds shall be written on the Performance Bond and Payment Bond forms included in the Bid Documents.

§ 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:

.1 AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor, SCOSE Version.

.2 AIA Document A101™–2017, Exhibit A, Insurance and Bonds, SCOSE Version.

.3 AIA Document A201™–2017, General Conditions of the Contract for Construction, SCOSE Version.

.4 Drawings

Number	Title	Date
See Exhibit A		

.5 Specifications

Section	Title	Date	Pages
See Exhibit A			

Init.

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.6 Addenda:

Number	Date	Pages

.7 Other Exhibits:
(Check all boxes that apply and include appropriate information identifying the exhibit where required.)

☐ AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, dated as indicated below:

☐ AIA Document E204™–2017, Sustainable Projects Exhibit, dated as indicated below:

☐ The Sustainability Plan:

☐ Supplementary and other Conditions of the Contract:

.8 Other documents listed below:
(List here any additional documents that are intended to form part of the Proposed Contract Documents.)

ARTICLE 9 Miscellaneous

§ 9.1 Nonresident Taxpayer Registration Affidavit Income Tax Withholding Important Tax Notice - Nonresidents Only

§ 9.1.1 Withholding Requirements for Payments to Nonresidents: SC Code of Laws §12-8-550 requires persons hiring or contracting with a nonresident conducting a business or performing personal services of a temporary nature within South Carolina to withhold 2% of each payment made to the nonresident. The withholding requirement does not apply to (1) payments on purchase orders for tangible personal property when the payments are not accompanied by services to be performed in South Carolina, (2) nonresidents who are not conducting business in South Carolina, (3) nonresidents for contracts that do not exceed $10,000 in a calendar year, or (4) payments to a nonresident who (a) registers with either the S.C. Department of Revenue or the S.C. Secretary of State and (b) submits a Nonresident Taxpayer Registration Affidavit - Income Tax Withholding, Form I-312 to the person letting the contract.

§ 9.1.2 For information about other withholding requirements (e.g., employee withholding), contact the Withholding Section at the South Carolina Department of Revenue at 803-898-5383 or visit the Department's website at: www.sctax.org

§ 9.1.3 This notice is for informational purposes only. This Owner does not administer and has no authority over tax issues. All registration questions should be directed to the License and Registration Section at 803-898-5872 or to the South Carolina Department of Revenue, Registration Unit, Columbia, S.C. 29214-0140. All withholding questions should be directed to the Withholding Section at 803-898-5383.

PLEASE SEE THE "NONRESIDENT TAXPAYER REGISTRATION AFFIDAVIT INCOME TAX WITHHOLDING" FORM (Available through SC Department of Revenue).

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§ 9.2 Submitting Confidential Information

§ 9.2.1 For every document the Bidder submits in response to or with regard to this solicitation or request, the Bidder must separately mark with the word "CONFIDENTIAL" every page, or portion thereof, that the Bidder contends contains information that is exempt from public disclosure because it is either (a) a trade secret as defined in Section 30-4-40(a)(1), or (b) privileged & confidential, as that phrase is used in SC Code of Laws §11-35-410.

§ 9.2.2 For every document the Bidder submits in response to or with regard to this solicitation or request, the Bidder must separately mark with the words "TRADE SECRET" every page, or portion thereof, that the Bidder contends contains a trade secret as that term is defined by SC Code of Laws §39-8-20.

§ 9.2.3 For every document the Bidder submits in response to or with regard to this solicitation or request, the Bidder must separately mark with the word "PROTECTED" every page, or portion thereof, that the Bidder contends is protected by SC Code of Laws §11-35-1810.

§ 9.2.4 All markings must be conspicuous; use color, bold, underlining, or some other method in order to conspicuously distinguish the mark from the other text. Do not mark your entire Bid as confidential, trade secret, or protected! If your Bid, or any part thereof, is improperly marked as confidential or trade secret or protected, the State may, in its sole discretion, determine it nonresponsive. If only portions of a page are subject to some protection, do not mark the entire page.

§ 9.2.5 By submitting a response to this solicitation, Bidder (1) agrees to the public disclosure of every page of every document regarding this solicitation or request that was submitted at any time prior to entering into a contract (including, but not limited to, documents contained in a response, documents submitted to clarify a response, & documents submitted during negotiations), unless the page is conspicuously marked "TRADE SECRET" or "CONFIDENTIAL" or "PROTECTED", (2) agrees that any information not marked, as required by these bidding instructions, as a "Trade Secret" is not a trade secret as defined by the Trade Secrets Act, & (3) agrees that, notwithstanding any claims or markings otherwise, any prices, commissions, discounts, or other financial figures used to determine the award, as well as the final contract amount, are subject to public disclosure.

§ 9.2.6 In determining whether to release documents, the State will detrimentally rely on the Bidders' marking of documents, as required by these bidding instructions, as being either "Confidential" or "Trade Secret" or "PROTECTED".

§ 9.2.7 By submitting a response, the Bidder agrees to defend, indemnify & hold harmless the State of South Carolina, its officers & employees, from every claim, demand, loss, expense, cost, damage or injury, including attorney's fees, arising out of or resulting from the State withholding information that Bidder marked as "confidential" or "trade secret" or "PROTECTED".

§ 9.3 Solicitation Information From Sources Other Than Official Source

South Carolina Business Opportunities (SCBO) is the official state government publication for State of South Carolina solicitations. Any information on State agency solicitations obtained from any other source is unofficial and any reliance placed on such information is at the Bidder's sole risk and is without recourse under the South Carolina Consolidated Procurement Code.

§ 9.4 Builder's Risk Insurance

Bidders are directed to Exhibit A of the AIA Document A101, 2017 SCOSE Version, which, unless provided otherwise in the Bid Documents, requires the contractor to provide builder's risk insurance on the project.

§ 9.5 Tax Credit For Subcontracting With Minority Firms

§ 9.5.1 Pursuant to S.C. Code Ann. §12-6-3350, taxpayers, who utilize certified minority subcontractors, may take a tax credit equal to 4% of the payments they make to said subcontractors. The payments claimed must be based on work performed directly for a South Carolina state contract. The credit is limited to a maximum of fifty thousand dollars annually. The taxpayer is eligible to claim the credit for 10 consecutive taxable years beginning with the taxable year in which the first payment is made to the subcontractor that qualifies for the credit. After the above ten consecutive taxable years, the taxpayer is no longer eligible for the credit. The credit may be claimed on Form TC-2, "Minority Business Credit." A copy of the subcontractor's certificate from the Governor's Office of Small and Minority Business (OSMBA) is to be attached to the contractor's income tax return.

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§ 9.5.2 Taxpayers must maintain evidence of work performed for a State contract by the minority subcontractor. Questions regarding the tax credit and how to file are to be referred to: SC Department of Revenue, Research and Review, Phone: (803) 898-5786, Fax: (803) 898-5888.

§ 9.5.3 The subcontractor must be certified as to the criteria of a "Minority Firm" by the Governor's Office of Small and Minority Business Assistance (OSMBA). Certificates are issued to subcontractors upon successful completion of the certification process. Questions regarding subcontractor certification are to be referred to: Governor's Office of Small and Minority Business Assistance, Phone: (803) 734-0657, Fax: (803) 734-2498. Reference: S.C. Code Ann. §11-35-5010 – Definition for Minority Subcontractor & S.C. Code Ann. §11-35-5230 (B) – Regulations for Negotiating with State Minority Firms.

§ 9.6 Other Special Conditions Of The Work

None

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AIA Document A310-2010

Bid Bond

The Bid Bond must be in the form of AIA Document A310-2010.
The document may be viewed and purchased at:

https://www.aiacontracts.org/contract-documents/18151-bid-bond

SE-330
LUMP SUM BID FORM

Bidders shall submit bids on only Bid Form SE-330.

BID SUBMITTED BY: _____

(Bidder's Name)

BID SUBMITTED TO: Spartanburg Community College

(Agency's Name)

FOR: PROJECT NAME: Tyger River Building Cosmetology Renovation

PROJECT NUMBER: H59-N306-JM

OFFER

§ 1. In response to the Invitation for Construction Services and in compliance with the Instructions to Bidders for the above-named Project, the undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into a Contract with the Agency on the terms included in the Bidding Documents, and to perform all Work as specified or indicated in the Bidding Documents, for the prices and within the time frames indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

§ 2. Pursuant to SC Code § 11-35-3030(1), Bidder has submitted Bid Security in the amount and form required by the Bidding Documents.

§ 3. Bidder acknowledges the receipt of the following Addenda to the Bidding Documents and has incorporated the effects of said Addenda into this Bid:

(Bidder, check all that apply. Note, there may be more boxes than actual addenda. Do not check boxes that do not apply)

ADDENDA: ☐ **#1** ☐ **#2** ☐ **#3** ☐ **#4** ☐ **#5**

§ 4. Bidder accepts all terms and conditions of the Invitation for Bids, including, without limitation, those dealing with the disposition of Bid Security. Bidder agrees that this Bid, including all Bid Alternates, if any, may not be revoked or withdrawn after the opening of bids, and shall remain open for acceptance for a period of **60** Days following the Bid Date, or for such longer period of time that Bidder may agree to in writing upon request of the Agency.

§ 5. Bidder herewith offers to provide all labor, materials, equipment, tools of trades and labor, accessories, appliances, warranties and guarantees, and to pay all royalties, fees, permits, licenses and applicable taxes necessary to complete the following items of construction work:

§ 6.1 BASE BID WORK ***(as indicated in the Bidding Documents and generally described as follows)*****:** Renovation of approximately 14,000SF with limited space reconfiguration for cosmetology to include 40 styling stations, 4 hair washing stations, manicure stations, pedicure stations and two academic classrooms. In addition to the Project includes the renovation of upper level restrooms, new finishes, lighting, and HVAC throughout the second floor.

$ _____, which sum is hereafter called the Base Bid.

(Bidder to insert Base Bid Amount on line above)

SE-330
LUMP SUM BID FORM

Bidders shall submit bids on only Bid Form SE-330.

§ 6.2 BID ALTERNATES as indicated in the Bidding Documents and generally described as follows:

ALTERNATE # 1 *(Brief Description)*: Renovation of the lower level restroom

☒ **ADD TO** or ☐ **DEDUCT FROM BASE BID: $** _____

(Bidder to mark appropriate box to clearly indicate the price adjustment offered for each Alternate)

ALTERNATE # 2 *(Brief Description)*: _____

☐ **ADD TO** or ☐ **DEDUCT FROM BASE BID: $** _____

(Bidder to mark appropriate box to clearly indicate the price adjustment offered for each Alternate)

ALTERNATE # 3 *(Brief Description)*: _____

☐ **ADD TO** or ☐ **DEDUCT FROM BASE BID: $** _____

(Bidder to mark appropriate box to clearly indicate the price adjustment offered for each Alternate)

§ 6.3 UNIT PRICES:

BIDDER offers for the Agency's consideration and use, the following UNIT PRICES. The UNIT PRICES offered by BIDDER indicate the amount to be added to or deducted from the CONTRACT SUM for each item-unit combination. UNIT PRICES include all costs to the Agency, including those for materials, labor, equipment, tools of trades and labor, fees, taxes, insurance, bonding, overhead, profit, etc. The Agency reserves the right to include or not to include any of the following UNIT PRICES in the Contract and to negotiate the UNIT PRICES with BIDDER prior to including in the Contract.

No.	ITEM	UNIT OF MEASURE	ADD	DEDUCT
1.			$	$
2.			$	$
3.			$	$
4.			$	$
5.			$	$
6.			$	$

SE-330
LUMP SUM BID FORM

§ 7. LISTING OF PROPOSED SUBCONTRACTORS PURSUANT TO SECTION 3020(b)(i), CHAPTER 35, TITLE 11 OF THE SOUTH CAROLINA CODE OF LAWS, AS AMENDED

(See Instructions on page BF-2A)

Bidder shall use the below-listed Subcontractors in the performance of the Subcontractor Classification work listed:

(A) **LICENSE CLASSIFICATION or SUBCLASSIFICATION ABBREVIATION per SCLLR** *(Completed by Agency)*	**(B)** **NAME of SUBCONTRACTOR and/or PRIME CONTRACTOR** *(Completed by Bidder)*	**(C)** **SUBCONTRACTOR'S and/or PRIME CONTRACTOR'S SC LICENSE NUMBER** *(Completed by Bidder)*
BASE BID		
AC		
EL		
PB		
ALTERNATE #1		
ALTERNATE #2		
ALTERNATE #3		

SE-330
LUMP SUM BID FORM

INSTRUCTIONS FOR SUBCONTRACTOR LISTING

1. Section 7 of the Bid Form sets forth an Agency-developed list of subcontractor license classifications or subclassifications for which Bidder is required to identify the entity (subcontractor(s) and/or prime) Bidder will use to perform this work.
   a. **Column A**: The Agency enters the appropriate SCLLR abbreviation to identify the subcontractor license classification / subclassification for which the Bidder is required to list either a subcontractor or itself as the entity that will perform the work. Abbreviations of licenses can be found at:
   https://llr.sc.gov/clb/PDFFiles/CLBClassificationAbbreviations.pdf. If the Agnecy has not identified a subcontractor license classification/subclassification, the Bidder does not list a subcontractor.
   b. **Columns B and C:** The Bidder identifies the subcontractors, by name and license number, it will use for the work of each license listed by the Agency in Column A. Bidder must identify only the subcontractor(s) who will perform the work and no others. Bidders must make sure that their identification of each subcontractor is clear and unambiguous. A listing that could be any number of different entities may be cause for rejection of the bid as non-responsive. For example, a listing of M&M without additional information may be problematic if there are multiple different licensed contractors in South Carolina whose names start with M&M.
2. **Subcontractor Defined:** For purposes of subcontractor listing, a subcontractor is an entity who will perform work or render service to the prime contractor to or about the construction site pursuant to a contract with the prime contractor. Bidder should not identify sub-subcontractors in the spaces provided on the bid form but only those entities with which Bidder will contract directly. Do not identify material suppliers, manufacturers, and fabricators that will not perform physical work at the site of the project but will only supply materials or equipment to the Bidder or proposed subcontractor(s).
3. **Subcontractor Qualifications:** Bidder must only list subcontractors who possess a South Carolina contractor's license that includes the license classification and/or subclassification identified by the Agency in Column A. The subcontractor license must also be within the appropriate license group for the work (do not list the Group number). If Bidder lists a subcontractor who is not qualified to perform the work, the Bidder will be rejected as non-responsible.
4. **Use of Own forces:** If, under the terms of the Bidding Documents and SC Contractor Licensing laws, Bidder is qualified to perform the work of a listed subcontractor classification or subclassification and Bidder does not intend to subcontract such work but to use Bidder's own employees to perform such work, the Bidder must insert itself in the space provided.
5. **Use of Multiple Subcontractors:**
   a. If Bidder intends to use multiple subcontractors to perform the work of a single license classification/subclassification, Bidder must insert the name of each subcontractor Bidder will use, preferably separating the name of each by the word **"and"**. If Bidder intends to use both his own employees to perform a part of the work of a single license classification/subclassification and to use one or more subcontractors to perform the remaining work, Bidder must insert itself and each subcontractor, preferably separating them with the word **"and"**. Bidder must use each entity listed for the work of a single license classification/subclassification in the performance of that work.
   b. **Optional Listing Prohibited:** Bidder may not list multiple subcontractors for a license classification/subclassification in a form that provides the Bidder the option, after bid opening or award, to choose one or more but not all the listed subcontractors to perform the work for which they are listed. A listing, which on its face requires subsequent explanation to determine whether it is an optional listing, is non-responsive. If Bidder intends to use multiple entities to perform the work for a single listing, Bidder must clearly set forth on the bid form such intent. Bidder may accomplish this by simply inserting the word "**and**" between the names of each entity listed. Agency will reject as non-responsive a listing that contains the names of multiple subcontractors separated by a blank space, the word "or", a virgule (that is a /), or any separator that the Agency may reasonably interpret as an optional listing.
6. If Bidder is awarded the contract, Bidder will not be allowed to substitute another entity as subcontractor in place of a subcontractor listed in Section 7 of the Bid except for one or more of the reasons allowed by the SC Code of Laws.
7. Bidder's failure to identify an entity (subcontractor or itself) to perform the work of a subcontractor listed in Column A will render the Bid non-responsive.

SE-330
LUMP SUM BID FORM

§ 8. LIST OF MANUFACTURERS, MATERIAL SUPPLIERS, AND SUBCONTRACTORS OTHER THAN SUBCONTRACTORS LISTED IN SECTION 7 ABOVE *(FOR INFORMATION ONLY):*

Pursuant to instructions in the Invitation for Construction Services, if any, Bidder will provide to Agency upon the Agency's request and within 24 hours of such request, a listing of manufacturers, material suppliers, and subcontractors, other than those listed in Section 7 above, that Bidder intends to use on the project. Bidder acknowledges and agrees that this list is provided for purposes of determining responsibility and not pursuant to the subcontractor listing requirements of SC Code § 11-35-3020(b)(i).

§ 9. TIME OF CONTRACT PERFORMANCE AND LIQUIDATED DAMAGES

a) CONTRACT TIME

Bidder agrees that the Date of Commencement of the Work shall be established in a Notice to Proceed to be issued by the Agency. Bidder agrees to substantially complete the Work within **105** Calendar Days from the Date of Commencement, subject to adjustments as provided in the Contract Documents.

b) LIQUIDATED DAMAGES

Bidder further agrees that from the compensation to be paid, the Agency shall retain as Liquidated Damages the amount of $**250.00** for each Calendar Day the actual construction time required to achieve Substantial Completion exceeds the specified or adjusted time for Substantial Completion as provided in the Contract Documents. This amount is intended by the parties as the predetermined measure of compensation for actual damages, not as a penalty for nonperformance.

§ 10. AGREEMENTS

a) Bidder agrees that this bid is subject to the requirements of the laws of the State of South Carolina.

b) Bidder agrees that at any time prior to the issuance of the Notice to Proceed for this Project, this Project may be canceled for the convenience of, and without cost to, the State.

c) Bidder agrees that neither the State of South Carolina nor any of its agencies, employees or agents shall be responsible for any bid preparation costs, or any costs or charges of any type, should all bids be rejected or the Project canceled for any reason prior to the issuance of the Notice to Proceed.

§ 11. ELECTRONIC BID BOND

By signing below, the Principal is affirming that the identified electronic bid bond has been executed and that the Principal and Surety are firmly bound unto the State of South Carolina under the terms and conditions of the AIA Document A310, Bid Bond, referenced in the Bidding Documents.

ELECTRONIC BID BOND NUMBER: _____

SIGNATURE AND TITLE: _____

SE-330
LUMP SUM BID FORM

CONTRACTOR'S CLASSIFICATIONS AND SUBCLASSIFICATIONS WITH LIMITATION

SC Contractor's License Number(s): _____

Classification(s) & Limits: _____

Subclassification(s) & Limits: _____

By signing this Bid, the person signing reaffirms all representation and certification made by both the person signing and the Bidder, including without limitation, those appearing in Article 2 of the SCOSE Version of the AIA Document A701, Instructions to Bidders, is expressly incorporated by reference.

BIDDER'S LEGAL NAME: _____

ADDRESS: _____

_____

TELEPHONE: _____

EMAIL: _____

SIGNATURE: _____ **DATE:** _____

PRINT NAME: _____

TITLE: _____

South Carolina Division of Procurement Services, Office of State Engineer Version of AIA® Document A101® – 2017

Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum

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Cite this document as "AIA Document A101®–2017, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum — SCOSE Version," or "AIA Document A101®–2017 — SCOSE Version."

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South Carolina Division of Procurement Services, Office of State Engineer Version of 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)

Spartanburg Community College
131 Community College Drive
Spartanburg, SC 29303

The Owner is a Governmental Body of the State of South Carolina as defined in S.C. Code Ann. § 11-35-310.

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

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

Tyger River Building Cosmetology Renovation
H59-N306-JM
1875 E. Main Street, Duncan, SC 29334

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

Moseley Architects P.C.
6210 Ardrey Kell Road, The Hub at Waverly, Suite 425
Charlotte, NC 28277

The Owner and Contractor agree as follows.

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

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EXHIBIT A INSURANCE AND BONDS

ARTICLE 1 THE CONTRACT DOCUMENTS

§ 1.1 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.

§ 1.2 Any reference in this document to the Agreement between the Owner and Contractor, AIA Document A101, or some abbreviated reference thereof, shall mean the AIA A101-2017 Standard Form of Agreement Between Owner and Contractor, SCOSE Version. Any reference in this document to the General Conditions of the Contract for Construction, AIA Document A201, or some abbreviated reference thereof, shall mean the AIA A201-2017 General Conditions of the Contract for Construction, SCOSE Version.

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.

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The Date of Commencement of the Work shall be the date fixed in a Notice to Proceed issued by the Owner. The Owner shall issue the Notice to Proceed to the Contractor in writing, no less than seven (7) days prior to the Date of Commencement. Unless otherwise provided elsewhere in the Contract Documents and provided the Contractor has secured all required insurance and surety bonds, the Contractor may commence work immediately after receipt of the Notice to Proceed.

§ 3.2 The Contract Time as provided in the Notice to Proceed for this project shall be measured from the Date of Commencement of the Work to Substantial Completion.

§ 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 within the Contract Time indicated in the Notice to Proceed.

§ 3.3.2 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.

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ARTICLE 4 CONTRACT SUM

§ 4.1 The Owner shall pay the Contractor the Contract Sum, including all accepted alternates indicated in the bid documents, in current funds for the Contractor's performance of the Contract. The Contract Sum shall be

($), subject to additions and deductions as provided in the Contract Documents.

§ 4.2 Alternates

§ 4.2.1 Alternates that are accepted, if any, included in the Contract Sum:
(Insert the accepted Alternates.)

Item	Price

§ 4.3 Allowances, if any, included in the Contract Sum:
(Identify each allowance.)

Item	Price

§ 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 Liquidated damages

§ 4.5.1 Contractor agrees that from the compensation to be paid, the Owner shall retain as liquidated damages the amount indicated in Section 9(b) of the Bid Form for each calendar day the actual construction time required to achieve Substantial Completion exceeds the specified or adjusted time for Substantial Completion as provided in the Contract Documents. The liquidated damages amount is intended by the parties as the predetermined measure of compensation for actual damages, not as a penalty.

§ 4.6 Other:
(Insert provisions for bonus or other incentives, if any, that might result in a change to the Contract Sum.)

Not Applicable

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ARTICLE 5 PAYMENTS

§ 5.1 Progress Payments

§ 5.1.1 Based upon Applications for Payment submitted to the Architect and Owner 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 The Owner shall make payment of the certified amount to the Contractor not later than twenty-one (21) days after receipt of the Application for Payment.

§ 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 Subject to S.C. Code Ann. § 12-8-550 (Withholding Requirements for Payments to Non-Residents), in accordance with AIA Document A201®–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 three and one-half percent (3.5%), as retainage, from the payment otherwise due.

§ 5.1.7.2 When a portion, or division, of Work as listed in the Schedule of Values is 100% complete, that portion of the retained funds which is allocable to the completed division must be released to the Contractor. No later than ten (10) days after receipt of retained funds from the Owner, the Contractor shall pay to the subcontractor responsible for such completed work the full amount of retainage allocable to the subcontractor's work.

§ 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.

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§ 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 twenty-one (21) days after the issuance of the Architect's final Certificate for Payment.

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Claims and disputes shall be resolved in accordance with Article 15 of AIA Document A201–2017.

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.

§ 7.2 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:

§ 8.2.1 The Owner designates the individual listed below as its Senior Representative ("Owner's Senior Representative"), which individual has the responsibility for and, subject to Section 7.2.1 of the General Conditions, the authority to resolve disputes under Section 15.6 of the General Conditions:

Name: Ethan Burroughs
Title: Vice President of Finance
Address: 1875 E Main St., Duncan, SC 29334
Telephone: (864) 592-4614
Email: burroughse@sccsc.edu

§ 8.2.2 The Owner designates the individual listed below as its Owner's Representative, which individual has the authority and responsibility set forth in Section 2.1.1 of the General Conditions:

Name: Patrick Kennedy
Title: Project Manager
Address: 136 Community College Dr., Spartanburg, SC 29303
Telephone: (864)592-4614
Email: kennedyp@sccsc.edu

§ 8.3 The Contractor's representative:

§ 8.3.1 The Contractor designates the individual listed below as its Senior Representative ("Contractor's Senior Representative"), which individual has the responsibility for and authority to resolve disputes under Section 15.6 of the General Conditions:

Name:

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Title:

Address:

Telephone:

Email:

§ 8.3.2 The Contractor designates the individual listed below as its Contractor's Representative, which individual has the authority and responsibility set forth in Section 3.1.1 of the General Conditions:

Name:

Title:

Address:

Telephone:

Email:

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

§ 8.5 The Architect's representative:

Name: Shannon Calloway

Title: Senior Associate

Address: 6210 Ardrey Kell Road, The Hub at Waverly, Suite 425, Charlotte, NC 28277

Telephone: (704)540-3755

Email: scalloway@moseleyarchitects.com

§ 8.6 Insurance and Bonds

§ 8.6.1 The Owner and the Contractor shall purchase and maintain insurance as set forth in AIA Document A101®–2017, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, Exhibit A, Insurance and Bonds, and elsewhere in the Contract Documents.

§ 8.6.2 The Contractor shall provide bonds as set forth in AIA Document A101®–2017 Exhibit A, and elsewhere in the Contract Documents.

§ 8.7 Notice in electronic format, pursuant to Article 1 of AIA Document A201–2017, may be given in accordance with AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, if completed, or as otherwise set forth below:

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

§ 8.8 Other Provisions:

§ 8.8.1 Additional requirements, if any, for the Contractor's Construction Schedule are as follows:

(Check box if applicable to this Contract)

☑ The Construction Schedule shall be in a detailed precedence-style critical path management (CPM) or primavera-type format satisfactory to the Owner and the Architect that shall also (1) provide a graphic representation of all activities and events that will occur during performance of the Work; (2) identify each phase of construction and occupancy; and (3) set forth milestone dates that are critical in ensuring the timely and orderly completion of the Work in accordance with the requirements of the Contract Documents.

.1 Upon review by the Owner and the Architect for conformance with milestone dates and Construction Time given in the Bidding Documents, with associated Substantial Completion date, the Construction Schedule shall be deemed part of the Contract Documents and attached to the Agreement as an Exhibit. If returned for non-conformance, the Construction Schedule shall be promptly revised by the Contractor in accordance with the recommendations of the Owner and the Architect and resubmitted.

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.2 The Contactor shall monitor the progress of the Work for conformance with the requirements of the Construction Schedule and shall promptly advise the Owner of any delays or potential delays. Whenever the Construction Schedule no longer reflects actual conditions and progress of the Work or the Contract Time is modified in accordance with the terms of the Contract Documents, the Contractor shall update the Construction Schedule to reflect such conditions.

.3 In the event any progress report indicates any delays, the Contractor shall propose an affirmative plan to correct the delay, including overtime and/or additional labor, if necessary.

.4 In no event shall any progress report constitute an adjustment in the Contract Time, any milestone date, or the Contract Sum unless any such adjustment is agreed to by the Owner and authorized pursuant to Change Order.

§ 8.8.2 The Owner's review of the Contractor's schedule is not conducted for the purpose of either determining its accuracy, completeness, or approving the construction means, methods, techniques, sequences or procedures. The Owner's review shall not relieve the Contractor of any obligations.

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 This Agreement is comprised of the following documents:

.1 AIA Document A101®–2017, SCOSE Version Standard Form of Agreement Between Owner and Contractor

.2 AIA Document A101®–2017, Exhibit A, Insurance and Bonds

.3 AIA Document A201®–2017, SCOSE Version General Conditions of the Contract for Construction

.4 Form SE-390, Notice to Proceed – Construction Contract

.5 Drawings

Number	Title	Date

.6 Specifications

Section	Title	Date	Pages

.7 Addenda, if any:

Number	Date	Pages

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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.

.8 Other Exhibits:
(Check all boxes that apply and include appropriate information identifying the exhibit where required.)

☐ AIA Document E204™–2017, Sustainable Projects Exhibit, dated as indicated below:
(Insert the date of the E204-2017 incorporated into this Agreement.)

☐ The Sustainability Plan:

Title	Date	Pages

☐ Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

.9 Other documents, if any, listed below:
(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201®–2017 provides that the advertisement or invitation to bid, Instructions to Bidders, sample forms, the Contractor's bid or proposal, portions of Addenda relating to bidding or proposal requirements, and other information furnished by the Owner in anticipation of receiving bids or proposals, are not part of the Contract Documents unless enumerated in this Agreement. Any such documents should be listed here only if intended to be part of the Contract Documents.)

Form SE-310, Invitation for Construction Services
Instructions to Bidders (AIA Document A701-2018 OSE Version)
Form SE-330, Contractor's Bid (Completed Bid Form)
Form SE-370, Notice of Intent to Award
Certificate of Procurement Authority issued by the State Fiscal Accountability Authority

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

OWNER *(Signature)*	**CONTRACTOR** *(Signature)*
(Printed name and title)	*(Printed name and title)*

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South Carolina Division of Procurement Services, Office of State Engineer Version of AIA® Document A101® – 2017 Exhibit A

Insurance and Bonds

This Insurance and Bonds Exhibit is part of the Agreement, between the Owner and the Contractor, dated the day of in the year
(In words, indicate day, month and year.)

for the following **PROJECT**:
(Name, State Project Number, and location or address)

Tyger River Building Cosmetology Renovation
H59-N306-JM
1875 E. Main Street, Duncan, SC 29334

This version of AIA Document A101–2017 Exhibit A is modified by the South Carolina Division of Procurement, Office of State Engineer. Publication of this version of AIA Document A101 Exhibit A does not imply the American Institute of Architects' endorsement of any modification by the South Carolina Division of Procurement, Office of State Engineer.

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

THE OWNER:
(Name, legal status and address)

Spartanburg Community College
131 Community College Drive
Spartanburg, SC 29303

The Owner is a Governmental Body of the State of South Carolina as defined by Title 11, Chapter 35 of the South Carolina Code of Laws, as amended.

THE CONTRACTOR:
(Name, legal status and address)

TABLE OF ARTICLES

A.1 GENERAL

A.2 OWNER'S INSURANCE

A.3 CONTRACTOR'S INSURANCE AND BONDS

A.4 SPECIAL TERMS AND CONDITIONS

ARTICLE A.1 GENERAL

The Owner and Contractor shall purchase and maintain insurance, and provide bonds, as set forth in this Exhibit. As used in this Exhibit, the term General Conditions refers to AIA Document A201®–2017, General Conditions of the Contract for Construction, SCOSE Version.

Init.
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ARTICLE A.2 OWNER'S INSURANCE

§ A.2.1 General

Prior to commencement of the Work, the Owner shall secure the insurance, and provide evidence of the coverage, required under this Article A.2 and, upon the Contractor's request, provide a copy of the policies required by Section A.2.3. The copy of the policy or policies provided shall contain all applicable conditions, definitions, exclusions, and endorsements.

§ A.2.2 Liability Insurance

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

§ A.2.3 Reserved

§ A.2.3.1 Reserved

§ A.2.3.1.1 Reserved

§ A.2.3.1.2 Reserved

§ A.2.3.1.3 Reserved

§ A.2.3.1.4 Reserved

§ A.2.3.2 Reserved

§ A.2.3.3 Reserved

§ A.2.4 Optional Insurance.

The Owner shall purchase and maintain any insurance selected below.

☐ **§ A.2.4.1 Other Insurance**

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

Coverage	Limits
Not Applicable	

ARTICLE A.3 CONTRACTOR'S INSURANCE AND BONDS

§ A.3.1 General

§ A.3.1.1 Certificates of Insurance. The Contractor shall provide certificates of insurance acceptable to the Owner evidencing compliance with the requirements in this Article A.3 at the following times: (1) prior to commencement of the Work; (2) upon renewal or replacement of each required policy of insurance; and (3) upon the Owner's written request. An additional certificate evidencing continuation of commercial liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment and thereafter upon renewal or replacement of such coverage until the expiration of the periods required by Section A.3.2.1 and Section A.3.3.1. The certificates will show the Owner as an additional insured on the Contractor's Commercial General Liability and excess or umbrella liability policy or policies. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, or both, shall be furnished by the Contractor with reasonable promptness.

§ A.3.1.2 Deductibles and Self-Insured Retentions. The Contractor shall disclose to the Owner any deductible or self-insured retentions applicable to any insurance required to be provided by the Contractor.

§ A.3.1.3 Additional Insured Obligations. To the fullest extent permitted by law, the Contractor shall cause the commercial general liability coverage to include (1) the Owner, the Architect, and the Architect's consultants as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the

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Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions for which loss occurs during completed operations. The additional insured coverage shall be primary and non-contributory to any of the Owner's general liability insurance policies and shall apply to both ongoing and completed operations, whether such operations be by the Contractor or by a Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable. To the extent commercially available, the additional insured coverage shall be no less than that provided by Insurance Services Office, Inc. (ISO) forms CG 20 10 07 04, CG 20 37 07 04, and, with respect to the Architect and the Architect's consultants, CG 20 32 07 04.

§ A.3.1.4 A failure by the Owner to either (i) demand a certificate of insurance or written endorsement required by Section A.3, or (ii) reject a certificate or endorsement on the grounds that it fails to comply with Section A.3, shall not be considered a waiver of Contractor's obligations to obtain the required insurance.

§ A.3.2 Contractor's Required Insurance Coverage

§ A.3.2.1 The Contractor shall purchase and maintain the following types and limits of insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Contractor shall maintain the required insurance until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions, for such other period for maintenance of completed operations coverage as specified in the Contract Documents, or unless a different duration is stated below:
(If the Contractor is required to maintain insurance for a duration other than the expiration of the period for correction of Work, state the duration.)

Not Applicable

§ A.3.2.2 Commercial General Liability

§ A.3.2.2.1 Commercial General Liability insurance for the Project written on an occurrence form with policy limits of not less than $1,000,000 each occurrence, $1,000,000 general aggregate, $1,000,000 aggregate for products-completed operations hazard, $1,000,000 personal and advertising injury, $50,000 fire damage (any one fire), and $5,000 medical expense (any one person) providing coverage for claims including

- **.1** damages because of bodily injury, sickness or disease, including occupational sickness or disease, and death of any person;
- **.2** personal injury and advertising injury;
- **.3** damages because of physical damage to or destruction of tangible property, including the loss of use of such property;
- **.4** bodily injury or property damage arising out of completed operations; and
- **.5** the Contractor's indemnity obligations under Section 3.18 of the General Conditions.

§ A.3.2.2.2 The Contractor's Commercial General Liability policy under this Section A.3.2.2 shall not contain an exclusion or restriction of coverage for the following:

- **.1** Claims by one insured against another insured, if the exclusion or restriction is based solely on the fact that the claimant is an insured, and there would otherwise be coverage for the claim.
- **.2** Claims for property damage to the Contractor's Work arising out of the products-completed operations hazard where the damaged Work or the Work out of which the damage arises was performed by a Subcontractor.
- **.3** Claims for bodily injury other than to employees of the insured.
- **.4** Claims for indemnity under Section 3.18 of the General Conditions arising out of injury to employees of the insured.
- **.5** Claims or loss excluded under a prior work endorsement or other similar exclusionary language.
- **.6** Claims or loss due to physical damage under a prior injury endorsement or similar exclusionary language.
- **.7** Claims related to residential, multi-family, or other habitational projects, if the Work is to be performed on such a project.
- **.8** Claims related to roofing, if the Work involves roofing.
- **.9** Claims related to exterior insulation finish systems (EIFS), synthetic stucco or similar exterior coatings or surfaces, if the Work involves such coatings or surfaces.
- **.10** Claims related to earth subsidence or movement, where the Work involves such hazards.
- **.11** Claims related to explosion, collapse and underground hazards, where the Work involves such hazards.

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§ A.3.2.3 Automobile Liability covering vehicles owned, and non-owned vehicles used, by the Contractor, with policy limits of not less than $1,000,000 per accident, for bodily injury, death of any person, and property damage arising out of the ownership, maintenance and use of those motor vehicles along with any other statutorily required automobile coverage.

§ A.3.2.4 The Contractor may achieve the required limits and coverage for Commercial General Liability, Employers Liability, and Automobile Liability through a combination of primary and excess or umbrella liability insurance, provided such primary and excess or umbrella insurance policies result in the same or greater coverage as the coverages required under Section A.3.2.2 and A.3.2.3, and in no event shall any excess or umbrella liability insurance provide narrower coverage than the primary policy. The excess policy shall not require the exhaustion of the underlying limits only through the actual payment by the underlying insurers. The umbrella policy limits shall not be less than $3,000,000.

§ A.3.2.5 Workers' Compensation at statutory limits.

§ A.3.2.6 Employers' Liability with policy limits not less than $100,000 each accident, $100,000 each employee, and $500,000 policy limit for claims, disability benefit and other similar employee benefit acts that are applicable to the Work to be performed.

§ A.3.2.7 Jones Act, and the Longshore & Harbor Workers' Compensation Act, as required, if the Work involves hazards arising from work on or near navigable waterways, including vessels and docks.

§ A.3.2.8 Insurance for maritime liability risks associated with the operation of a vessel, if the Work requires such activities, with policy limits of not less than ($) per claim and ($) in the aggregate.

§ A.3.2.9 Insurance for the use or operation of manned or unmanned aircraft, if the Work requires such activities, with policy limits of not less than ($) per claim and ($) in the aggregate.

§ A.3.3 Required Property Insurance

§ A.3.3.1 The Contractor shall purchase and maintain, from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located, property insurance written on a builder's risk "all-risks" completed value or equivalent policy form and sufficient to cover the total value of the entire Project on a replacement cost basis. The Contractor's property insurance coverage shall be no less than the amount of the initial Contract Sum, plus the value of subsequent Modifications and labor performed and materials or equipment supplied by others. The property insurance shall be maintained until Substantial Completion and thereafter as provided in Section A.3.3.1.3, unless otherwise provided in the Contract Documents or otherwise agreed in writing by the parties to this Agreement. This insurance shall include the interests of the Owner, Contractor, Subcontractors, and Sub-subcontractors in the Project as insureds.

§ A.3.3.1.1 Causes of Loss. The insurance required by this Section A.3.3.1 shall provide coverage for direct physical loss or damage and shall include the risks of fire (with extended coverage), explosion, theft, vandalism, malicious mischief, collapse, earthquake, flood, or windstorm. The insurance shall also provide coverage for ensuing loss or resulting damage from error, omission, or deficiency in construction methods, workmanship, or materials.
(Indicate below the cause of loss and any applicable sub-limit.)

Causes of Loss	Sub-Limit
Not Applicable	

§ A.3.3.1.2 Specific Required Coverages. The insurance required by this Section A.3.3.1 shall provide coverage for loss or damage to falsework and other temporary structures, and to building systems from testing and startup. The insurance shall also cover debris removal, including demolition occasioned by enforcement of any applicable legal requirements, and reasonable compensation for the Architect's and Contractor's services and expenses required as a result of such insured loss, including claim preparation expenses. (Indicate below the cause of loss and any applicable sub-limit.)

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Causes of Loss	Sub-Limit

§ A.3.3.1.3 Unless the parties agree otherwise, upon Substantial Completion, the Owner shall replace the insurance policy required under Section A.3.3.1 with property insurance written for the total value of the Project.

§ A.3.3.1.4 Deductibles and Self-Insured Retentions. If the insurance required by this Section A.3.3 is subject to deductibles or self-insured retentions, the Contractor shall be responsible for all loss not covered because of such deductibles or retentions.

§ A.3.3.2 Occupancy or Use Prior to Substantial Completion. The Owner's occupancy or use of any completed or partially completed portion of the Work prior to Substantial Completion shall not commence until the insurance company or companies providing the insurance under Section A.3.3.1 have consented in writing to the continuance of coverage. The Owner and the Contractor shall take no action with respect to partial occupancy or use that would cause cancellation, lapse, or reduction of insurance, unless they agree otherwise in writing.

§ A.3.3.3 If the Owner requests in writing that insurance for risks other than those described herein or other special causes of loss be included in the property insurance policy, the Contractor shall, if possible, include such insurance, and the cost thereof shall be charged to the Owner by appropriate Change Order.

§ A.3.3.4 Before an exposure to loss may occur, the Contractor shall file with the Owner a copy of each policy that includes insurance coverages required by this Section A.3.3. Each policy shall contain all generally applicable conditions, definitions, exclusions and endorsements related to this Project.

§ A.3.4 Contractor's Other Insurance Coverage

§ A.3.4.1 Insurance selected and described in this Section A.3.4 shall be purchased from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Contractor shall maintain the required insurance until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions, unless a different duration is stated below:
(If the Contractor is required to maintain any of the types of insurance selected below for a duration other than the expiration of the period for correction of Work, state the duration.)

Not Applicable

§ A.3.4.2 The Contractor shall purchase and maintain the following types and limits of insurance in accordance with Section A.3.4.1.
(Select the types of insurance the Contractor is required to purchase and maintain by placing an X in the box(es) next to the description(s) of selected insurance. Where policy limits are provided, include the policy limit in the appropriate fill point.)

☐ **§ A.3.4.2.1 Reserved**

☐ **§ A.3.4.2.2** Insurance for physical damage to property while it is in storage and in transit to the construction site on an "all-risks" completed value form.

☐ **§ A.3.4.2.3** Property insurance on an "all-risks" completed value form, covering property owned by the Contractor and used on the Project, including scaffolding and other equipment.

☐ **§ A.3.4.2.4 Boiler and Machinery Insurance**
The Contractor shall purchase and maintain boiler and machinery insurance as required, which shall specifically cover such insured objects during installation and until final acceptance by the Owner; this

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insurance shall include interests of the Owner, Contractor, Subcontractors and Sub-subcontractors in the Work, and the Owner and Contractor shall be named insureds.

§ A.3.5 Performance Bond and Payment Bond

The Contractor shall provide surety bonds, from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located, as follows:
(Specify type and penal sum of bonds.)

Type	Penal Sum ($0.00)
Payment Bond	100% of Contract Price
Performance Bond	100% of Contract Price

§ A.3.5.1 Before commencing any services hereunder, the Contractor shall provide the Owner with Performance and Payment Bonds, each in an amount not less than the Contract Price set forth in Article 4 of the Agreement. The Surety shall have, at a minimum, a "Best Rating" of "A" as stated in the most current publication of "Best's Key Rating Guide, Property-Casualty". In addition, the Surety shall have a minimum "Best Financial Strength Category" of "Class V", and in no case less than five (5) times the contract amount. The Performance Bond shall be written on Form SE-355, "Performance Bond" and the Payment Bond shall be written on Form SE-357, "Labor and Material Payment Bond", and both shall be made payable to the Owner.

§ A.3.5.2 The Performance and Labor and Material Payment Bonds shall:

.1 be issued by a surety company licensed to do business in South Carolina;

.2 be accompanied by a current power of attorney and certified by the attorney-in-fact who executes the bond on the behalf of the surety company; and

.3 remain in effect for a period not less than one (1) year following the date of Substantial Completion or the time required to resolve any items of incomplete Work and the payment of any disputed amounts, whichever time period is longer.

§ A.3.5.3 Any bonds required by this Contract shall meet the requirements of the South Carolina Code of Laws and Regulations, as amended.

ARTICLE A.4 SPECIAL TERMS AND CONDITIONS

Special terms and conditions that modify this Insurance and Bonds Exhibit, if any, are as follows:

None

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General Conditions of the Contract for Construction

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South Carolina Division of Procurement Services, Office of State Engineer Version of AIA® Document A201® – 2017

General Conditions of the Contract for Construction

for the following PROJECT:
(Name, State Project Number, and location or address)

Tyger River Building Cosmetology Renovation
H59-N306-JM
1875 E. Main Street, Duncan, SC 29334

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

Spartanburg Community College
131 Community College Drive
Spartanburg, SC 29303

The Owner is a Governmental Body of the State of South Carolina as defined in S.C. Code Ann.§ 11-35-310.

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

Moseley Architects P.C.
6210 Ardrey Kell Road, The Hub at Waverly, Suite 425
Charlotte, NC 28277

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

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1.1.1, 2.4, 3.9, 7, 8.2.2, 12.1, 12.2, 13.4.2, 14.3.1

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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

.1 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.

.2 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.

.3 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.

.4 Any reference in this document to the Agreement between the Owner and Contractor, AIA Document A101, or some abbreviated reference thereof, shall mean the AIA A101-2017, Standard Form of Agreement Between Owner and Contractor, SCOSE Version.

.5 Any reference in this document to the General Conditions of the Contract for Construction, AIA Document A201, or some abbreviated reference thereof, shall mean the AIA A201-2017, General Conditions of the Contract for Construction, SCOSE Version.

§ 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's consultants, or (4) between any persons or entities other than the Owner and the Contractor.

§ 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.

§ 1.1.7 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 Reserved

§ 1.1.9 Notice to Proceed

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The Notice to Proceed is a document issued by the Owner to the Contractor directing the Contractor to begin prosecution of the Work in accordance with the requirements of the Contract Documents. The Notice to Proceed shall fix the date on which the Contract Time will commence and establish the initial date of the Substantial Completion.

§ 1.1.10 State Engineer

"State Engineer" means the person holding the position as head of the State Engineer's Office. The State Engineer's Office is created by S.C. Code Ann. § 11-35-830, and is sometimes referred to in the Contract Documents as "Office of State Engineer" or "OSE." The State Engineer is also the Chief Procurement Officer for Construction, sometimes referred to in the Contract Documents as "CPOC".

§ 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. In the event of patent ambiguities within or between parts of the Contract Documents, the Contractor shall 1) provide the better quality or greater quantity of Work, or 2) comply with the more stringent requirement, either or both in accordance with the Architect's interpretation.

§ 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, such determination shall not impair or otherwise affect the validity, legality, or enforceability of the remaining provision or parts of the provision of the Contract Documents, which shall remain in full force and effect as if the unenforceable provision or part were deleted.

§ 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.

§ 1.3 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.

§ 1.5 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 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 Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as a violation 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

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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.

§ 1.6.3 Notice to Contractor shall be to the address provided in Section 8.3.2 of the Agreement. Notice to Owner shall be to the address provided in Section 8.2.2 of the Agreement. Either party may designate a different address for notice by giving notice in accordance with Section 1.6.1.

§ 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, including in digital form. The parties will use AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, to establish the protocols for the development, use, transmission, and exchange of digital data.

§ 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 AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document G202™–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 provided in Section 7.1.7. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's Representative noted in the Agreement.

§ 2.1.2 The Owner shall furnish to the Contractor, within fifteen (15) days after receipt of a written request, information necessary and relevant for the Contractor to post Notice of Project Commencement pursuant to S.C. Code Ann. § 29-5-23.

§ 2.2 Reserved

§ 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.

§ 2.3.2 The Owner shall retain a design professional lawfully licensed to practice, or an entity lawfully practicing, in the jurisdiction where the Project is located. The 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. Subject to the Contractor's obligations, including those in Section 3.2, the Contractor shall be entitled to rely on the accuracy of information furnished by the Owner pursuant to this Section but shall exercise proper precautions relating to the safe performance of the Work.

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§ 2.3.5 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services. However, the Owner does not warrant the accuracy of any such information requested by the Contractor that is not otherwise required of the Owner by the Contract Documents. Neither the Owner nor the Architect shall be required to conduct investigations or to furnish the Contractor with any information concerning subsurface characteristics or other conditions of the area where the Work is to be performed beyond that which is provided in the Contract Documents.

§ 2.3.6 The Owner shall furnish the Contract Documents to the Contractor in digital format.

§ 2.4 Owner's Right to Stop the Work

If the Contractor fails to 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 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, including but not limited to providing necessary resources, 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 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 Representative noted in the Agreement.

§ 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.

§ 3.2 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 local conditions under which the Work is to be performed, and correlated personal observations with requirements of the Contract Documents.

.1 The Contractor acknowledges that it has investigated and satisfied itself as to the general and local conditions which can affect the Work or its cost, including but not limited to (a) conditions bearing upon transportation, disposal, handling, and storage of materials; (b) the availability of labor, water, electric power, and roads; (c) uncertainties of weather, river stages, tides, or similar physical conditions at the site; (d) the conformation and conditions of the ground; and (e) the character of equipment and facilities needed preliminary to and during work performance.

.2 The Contractor also acknowledges that it has satisfied itself as to the character, quality, and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is

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reasonably ascertainable from an inspection of the site, including all exploratory work done by the Owner, as well as from the drawings and specifications made a part of this Contract.

.3 Any failure of the Contractor to take the actions described and acknowledged in this Section will not relieve the Contractor from responsibility for estimating properly the difficulty and cost of successfully performing the Work, or for proceeding to successfully perform the Work without additional expense to the Owner.

§ 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 Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided 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.

§ 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 latent 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.

§ 3.2.5 The Owner is entitled to reimbursement from the Contractor for amounts paid to the Architect for evaluating and responding to the Contractor's requests for information that are not prepared in accordance with the Contract Documents or where the requested information is available to the Contractor from a careful study and comparison of the Contract Documents, field conditions, other Owner-provided information, Contractor-prepared coordination drawings, or prior Project correspondence or documentation.

§ 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 and provide its findings to the Owner. Unless the Owner objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative means, methods, techniques, sequences, or procedures.

§ 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.

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§ 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.

§ 3.4.2.1 After the Contract has been executed, the Owner and Architect may consider requests for the substitution of products in place of those specified. The Owner and Architect may, but are not obligated to, consider only those substitution requests that are in full compliance with the conditions set forth in the General Requirements (Division 1 of the Specifications). By making requests for substitutions, the Contractor:

- **.1** represents that it has personally investigated the proposed substitute product and determined that it is equal or superior in all respects to the product specified;
- **.2** represents that it will provide the same warranty for the substitution as it would have provided for the product specified;
- **.3** certifies that the cost data presented is complete and includes all related costs for the substituted product and for Work that must be performed or changes as a result of the substitution, except for the Architect's re-design costs, and waives all claims for additional costs related to the substitution that subsequently become apparent;
- **.4** agrees that it shall, if the substitution is approved, coordinate the installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects; and
- **.5** represents that the request includes a written representation identifying any potential effect the substitution may have on Project's achievement of a Sustainable Measure or the Sustainable Objective.

§ 3.4.2.2 The Owner shall be entitled to reimbursement from the Contractor for amounts paid to the Architect for reviewing the Contractor's proposed substitutions and making agreed-upon changes in the Drawings and Specifications resulting from such substitutions.

§ 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 shall be considered defective. Unless caused by the Contractor or a subcontractor at any tier, 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, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 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. The Contractor shall comply with the requirements of S.C Code Ann. Title 12, Chapter 8, regarding withholding tax for nonresidents, employees, contractors and subcontractors.

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§ 3.7 Permits, Fees, Notices and Compliance with Laws

§ 3.7.1 Pursuant to S.C. Code Ann. § 10-1-180, no local general or specialty building permits are required for state buildings. Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for all other permits, fees, and licenses by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 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 suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 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 the difference between actual costs, as documented by invoices, and the allowances under Section 3.8.2.1.

§ 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, acceptable to the Owner, 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.

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§ 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 Owner may notify the Contractor, stating whether the Owner has reasonable objection to the proposed superintendent. Failure of the Owner 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 has made reasonable and timely objection. The Contractor shall notify the Owner of any proposed change in the superintendent, including the reason therefore, prior to making such change. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

§ 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. Subject to any additional requirements in the Contract Documents, the schedule shall contain detail appropriate for the Project, including at a minimum (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.

§ 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 the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

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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.

.1 The fire sprinkler shop drawings shall be prepared by a licensed fire sprinkler contractor and shall accurately reflect actual conditions affecting the required layout of the fire sprinkler system. The fire sprinkler contractor shall certify the accuracy of its shop drawings and submit the drawings and hydraulic calculations to the Architect's fire protection engineer (FPE) for review and approval.

.2 The FPE will review, approve, and submit to the Office of State Fire Marshal (OSFM) the fire sprinkler shop drawings and FPE's certification indicating the shop drawings and hydraulic calculations have been reviewed and approved prior to OSFM review.

.3 Unless authorized in writing by OSE, neither the Contractor nor subcontractor at any tier shall submit the fire sprinkler shop drawings directly to OSFM.

§ 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, who shall comply with reasonable requirements of the Owner regarding qualifications and insurance and 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

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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 The Contractor shall not be responsible for the adequacy of the performance and design criteria specified in the Contract Documents.

§ 3.13 Use of Site

§ 3.13.1 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.

§ 3.13.2 The Contractor and any entity for which the Contractor is responsible shall not erect any sign on the Project site without the prior written consent of the Owner.

§ 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, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself) including loss of use resulting therefrom, but

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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.

§ 3.18.2 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. Any reference in the Contract Documents to the Architect taking action or rendering a decision with a "reasonable time" is understood to mean no more than ten (10) days, unless otherwise specified in the Contract Documents or otherwise agreed to by the parties.

§ 4.2.2 The Architect will visit the site as necessary to fulfill its obligation to the Owner for inspection services, if any, and, at a minimum, to assure conformance with the Architect's design as shown in the Contract Documents and to observe 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 informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) deviations from the Contract Documents, (2) 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.

§ 4.2.5 Based on the Architect's evaluations of the Work completed and correlated with 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 has 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, in the first instance, interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. Upon receipt of such request, the Architect will promptly provide the other party with a copy of the request. 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, and will not show partiality to either. Except in the case of interpretations resulting in omissions, defects, or errors in the Instruments of Service or perpetuating omissions, defects or errors in the Instruments of Service, the Architect will not be liable for results of interpretations or decisions rendered in good faith. If either party disputes the Architect's interpretation or decision, that party may proceed as provided in Article 15. The Architect's interpretations and decisions may be, but need not be, accorded any deference in any review conducted pursuant to law or the Contract Documents.

§ 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 so as to avoid delay to the construction of the Project. The Architect's response to such requests will be made in writing with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information. Any response to a request for information must be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings.

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Unless issued pursuant to a Modification, supplemental Drawings or Specifications will not involve an adjustment to the Contract Sum or Contract Time.

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.

§ 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, within fourteen (14) days after posting of the Notice of Intent to Award 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 Owner may notify the Contractor whether the Owner has reasonable objection to any such proposed person or entity. Failure of the Owner to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner has made reasonable and timely objection. The Owner shall not direct the Contractor to contract with any specific individual or entity for supplies or services unless such supplies and services are necessary for completion of the Work and the specified individual or entity is the only source of such supply or service.

§ 5.2.3 If the Owner has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner 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 makes reasonable objection to such substitution. The Contractor's request for substitution must be made to the Owner in writing, accompanied by supporting information.

§ 5.2.5 A Subcontractor identified in the Contractor's Bid pursuant to the subcontractor listing requirements of Section 7 of the Bid Form may only be substituted in accordance with and as permitted by the provisions of S.C. Code Ann. § 11-35-3021. A proposed substitute for a listed subcontractor shall also be subject to the Owner's approval as set forth in Section 5.2.3.

§ 5.2.6 A Contractor may substitute one prospective subcontractor for another, with the approval of the Owner as follows:

- **.1** If the Contractor requests the substitution, the Contractor is responsible for all costs associated with the substitution.
- **.2** If the Owner requests the substitution, the Owner is responsible for any resulting increased costs to the Contractor.

§ 5.3 Subcontractual Relations

§ 5.3.1 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

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prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise herein, or 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.

§ 5.3.2 Without limitation on the generality of Section 5.3.1, each Subcontract agreement and each Sub-subcontract agreement shall include, and shall be deemed to include, the following Sections of these General Conditions: 3.2, 3.5, 3.18, 5.3, 5.4, 6.2.2, 7.1.6, 7.3.3, 7.5, 13.1, 13.9, 14.3, 14.4, and 15.1.7.

§ 5.3.3 Each Subcontract Agreement and each Sub-subcontract agreement shall exclude, and shall be deemed to exclude, Sections 13.2 and 13.5 and all of Article 15, except Section 15.1.7, of these General Conditions. In the place of these excluded sections of the General Conditions, each Subcontract Agreement and each Sub-subcontract may include Sections 13.2 and 13.5 and all of Article 15, except Section 15.1.7, of AIA Document A201-2007, Conditions of the Contract, as originally issued by the American Institute of Architects.

§ 5.3.4 The Contractor shall assure the Owner that all agreements between the Contractor and its Subcontractor incorporate the provisions of Section 5.3.1 as necessary to preserve and protect the rights of the Owner and the Architect under the Contract Documents with respect to the work to be performed by Subcontractors so that the subcontracting thereof will not prejudice such rights. The Contractor's assurance shall be in the form of an affidavit or in such other form as the Owner may approve. Upon request, the Contractor shall provide the Owner or Architect with copies of any or all subcontracts or purchase orders.

§ 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

- **.1** assignment is effective only after termination of the Contract by the Owner for cause pursuant to 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.

§ 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.

§ 5.4.4 Each subcontract shall specifically provide that the Owner shall only be responsible to the subcontractor for those obligations of the Contractor that accrue subsequent to the Owner's exercise of any rights under this conditional assignment.

§ 5.4.5 Each subcontract shall specifically provide that the Subcontractor agrees to perform portions of the Work assigned to the Owner in accordance with the Contract Documents.

§ 5.4.6 Nothing in this Section 5.4 shall act to reduce or discharge the Contractor's payment bond surety's obligations to claimants for claims arising prior to the Owner's exercise of any rights under this conditional assignment.

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

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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.

§ 6.1.4 Reserved

§ 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.

§ 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.

ARTICLE 7 CHANGES IN THE WORK

§ 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.

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§ 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.

§ 7.1.4 If a change in the Work provides for an adjustment to the Contract Sum, the amount of such adjustment must be computed and documented in writing. In order to facilitate evaluation of proposals or claims for increases and decreases to the Contract Sum, all proposals or claims, except those so minor that their propriety can be seen by inspection, shall be accompanied by a complete itemization of costs including labor, materials and subcontracts. Labor and materials shall be itemized. Where major cost items are subcontracts, they shall be itemized also. The amount of the adjustment must approximate the actual cost to the Contractor and all costs incurred by the Contractor must be justifiably compared with prevailing industry standards. Except as provided in Section 7.1.5, all adjustments to the Contract Sum shall be limited to job specific costs and shall not include indirect costs, home office overhead or profit.

§ 7.1.5 The combined overhead and profit included in the total cost to the Owner for a change in the Work shall be based on the following schedule:

.1 For the Contractor, for Work performed by the Contractor's own forces, not to exceed seventeen (17%) percent of the Contractor's actual costs.

.2 For the Contractor, for Work performed by the Contractor's Subcontractors, not to exceed ten (10%) percent of each Subcontractor's actual costs (not including the Subcontractor's overhead and profit).

.3 For each Subcontractor involved, for Work performed by that Subcontractor's own forces, not to exceed seventeen (17%) percent of the Subcontractor's actual costs.

.4 Cost to which overhead and profit is to be applied shall be determined in accordance with Section 7.3.4.

The percentages cited above shall be considered to include all indirect costs including, but not limited to field and office managers, supervisors and assistants, incidental job burdens, small tools, and general overhead allocations.

§ 7.1.6 The procedures described in Sections 7.1.4 and 7.1.5 shall be used to calculate any adjustment in the Contract Sum, including without limitation an adjustment permitted under Articles 7, 9, 14, or 15.

§ 7.1.7 If a change in the Work requires an adjustment to the Contract Sum that exceeds the limits of the Owner's Construction Change Order Certification (reference Section 9.1.9 of the Agreement), then the Owner's agreement is not effective, and Work may not proceed until approved in writing by the OSE.

§ 7.1.8 Additional Work performed after the declaration of Substantial Completion must be approved by OSE, if the Change Order exceeds the Owner's Construction Change Order Certification.

§ 7.2 Change Orders

§ 7.2.1 A Change Order is a written instrument, using the OSE Construction Change Order form, 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.

Agreement on any Change Order shall constitute a final settlement of all matters relating to the change in the Work that is the subject of the Change Order, including, but not limited to, any adjustments to the Contract Sum or the Contract Time.

§ 7.2.2 At the Owner's request, the Contractor shall prepare a proposal to perform the work of a proposed Change Order setting forth the amount of the proposed adjustment, if any, in the Contract Sum; and the extent of the proposed adjustment, if any, in the Contract Time. Any proposed adjustment in the Contract Sum shall be prepared in accordance with Section 7.1.4 and 7.1.5. The Owner's request shall include any revisions to the Drawings or Specifications necessary to define any changes in the Work. Within fourteen (14) days of receiving the request, the Contractor shall submit the proposal to the Owner and Architect along with all documentation required by Section 7.5.

§ 7.2.3 If the Contractor requests a Change Order, the request shall set forth the proposed change in the Work and shall be prepared in accordance with Section 7.2.2. If the Contractor requests a change to the Work that involves a revision

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to either the Drawings or Specifications, the Contractor shall reimburse the Owner for any expenditure associated with the Architects' review of the proposed revisions, except to the extent the revisions are accepted by execution of a Change Order.

§ 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 if properly itemized and substantiating data is not available to permit evaluation;
- **.2** Unit prices specified in the Contract Documents or subsequently agreed upon, subject to adjustment if any, as provided in Section 9.1.2;
- **.3** Cost and a percentage fee, calculated as described in Sections 7.1.4 and 7.1.5;
- **.4** in another manner as the parties may agree; or
- **.5** 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 make an initial determination, consistent with Section 7.3.3, of the method and 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 Section 7.1.5. 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; and
- **.4** Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related 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.

§ 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 cost including overhead and profit as confirmed by the Architect from the Schedule of Values.

§ 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

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Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 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 waives any adjustment to the Contract Sum or extension of the Contract Time.

§ 7.5 Pricing Data and Audit

§ 7.5.1 Cost or Pricing Data

Upon request of the Owner or Architect, Contractor shall submit cost or pricing data prior to execution of a Modification which exceeds $500,000 [Reference S.C. Code Ann. §§ 11-35-1830 and 11-35-2220, and SC Code Ann. Reg 19-445.2120]. Contractor shall certify that, to the best of its knowledge and belief, the cost or pricing data submitted is accurate, complete, and current as of a mutually determined specified date prior to the date of pricing the Modification. Contractor's price, including profit, shall be adjusted to exclude any significant sums by which such price was increased because Contractor furnished cost or pricing data that was inaccurate, incomplete, or not current as of the date specified by the parties. Notwithstanding Subparagraph 9.10.4, such adjustments may be made after final payment to the Contractor.

§ 7.5.2 Cost or pricing data means all facts that, as of the date specified by the parties, prudent buyers and sellers would reasonably expect to affect price negotiations significantly. Cost or pricing data are factual, not judgmental; and are verifiable. While they do not indicate the accuracy of the prospective contractor's judgment about estimated future costs or projections, they do include the data forming the basis for that judgment. Cost or pricing data are more than historical accounting data; they are all the facts that can be reasonably expected to contribute to the soundness of estimates of future costs and to the validity of determinations of costs already incurred.

§ 7.5.3 Records Retention

As used in Section 7.5, the term "Records" means any books or records that relate to cost or pricing data of a Change Order that Contractor is required to submit pursuant to Section 7.5.1. Contractor shall maintain records for three years from the date of final payment, or longer if requested by the chief procurement officer. The Owner may audit Contractor's records at reasonable times and places.

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.

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§ 8.2.2 The Contractor shall not knowingly commence the Work prior to the effective date of surety bonds and 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 dispute resolution; or (5) by other causes that the Contractor asserts, and the Architect determines, justify delay, then to the extent such delay will prevent the Contractor from achieving Substantial Completion within the Contract Time, the Contract Time shall be extended for such reasonable time as the Architect may determine, provided the delay:

.1 is not caused by the fault or negligence of the Contractor or a subcontractor at any tier, and

.2 is not due to unusual delay in the delivery of supplies, machinery, equipment, or services when such supplies, machinery, equipment, or services were obtainable from other sources in sufficient time for the Contractor to meet the required delivery.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

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

§ 9.2.1 The Contractor shall submit a schedule of values to the Architect within ten (10) days of full execution of the Agreement, 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.

§ 9.2.2 As requested by the Architect, the Contractor and each Subcontractor shall prepare a trade payment breakdown for the Work for which each is responsible. The breakdown, being submitted on a uniform standardized format approved by the Architect and Owner, shall be divided in detail, using convenient units, sufficient to accurately determine the value of completed Work during the course of the Project. The Contractor shall update the schedule of values as required by either the Architect or Owner as necessary to reflect:

.1 the description of Work (listing labor and material separately);

.2 the total value of the Work;

.3 the percent and value of the Work completed to date;

.4 the percent and value of previous amounts billed; and

.5 the current percent completed, and amount billed.

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§ 9.2.3 Any schedule of values or trade breakdown that fails to provide sufficient detail, is unbalanced, or exhibits "front-loading" of the value of the Work shall be rejected. If a schedule of values or trade breakdown is used as the basis for payment and later determined to be inaccurate, sufficient funds shall be withheld from future Applications for Payment to ensure an adequate reserve (exclusive of normal retainage) to complete the Work.

§ 9.3 Applications for Payment

§ 9.3.1 Monthly, 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 as 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.

§ 9.3.2 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, provided such materials or equipment will be subsequently incorporated in the Work. 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. The Contractor shall 1) protect such materials from diversion, vandalism, theft, destruction, and damage, 2) mark such materials specifically for use on the Project, and 3) segregate such materials from other materials at the storage facility. The Architect and the Owner shall have the right to make inspections of the storage areas at any time.

§ 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.

§ 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 reason for withholding certification in whole as provided in Section 9.5.1.

§ 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 in both the Application for Payment and, if required to be submitted, the accompanying current construction schedule, 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,

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methods, techniques, sequences, or procedures; or (3) 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 shall 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. The Architect shall withhold a Certificate of Payment if the Application for Payment is not accompanied by the current construction schedule required by Section 3.10.1. 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;
- **.2** third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
- **.3** failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;
- **.4** reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- **.5** damage to the Owner or a Separate Contractor;
- **.6** reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
- **.7** repeated failure to carry out the Work in accordance with the Contract Documents.

§ 9.5.2 When either party disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, that party may submit a Claim in accordance with Article 15.

§ 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.

§ 9.6.2 Pursuant to S.C. Ann. §§ 29-6-10 through 29-6-60, 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.

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§ 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.

§ 9.7 Failure of Payment

If the Architect does not issue a Certificate for Payment to the Owner, 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 time established in the Contract Documents, the amount certified by the Architect or awarded by final dispute resolution order, 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.

§ 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 written 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, the Owner, and any other party the Architect or the Owner choose, will make an inspection on a date and at a time mutually agreeable to determine whether the Work or designated portion thereof is substantially complete. The Contractor shall furnish access for the inspection and testing as provided in this Contract. The inspection shall include a demonstration by the Contractor that all equipment, systems and operable components of the Work function properly and in accordance with the Contract Documents.

- **.1** 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.
- **.2** If more than one Substantial Completion inspection is required, the Contractor shall reimburse the Owner for all costs of re-inspections or, at the Owner's option, the costs may be deducted from payments due to the Contractor.
- **.3** Representatives of the State Fire Marshal's Office and other authorities having jurisdiction may be present at the Substantial Completion inspection or otherwise inspect the completed Work and advise the Owner whether the Work meets their respective requirements for the Project.

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§ 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 for its written acceptance of responsibilities assigned in the Certificate and a copy of the signed Certificate shall be delivered to the Contractor. Upon such acceptance, 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.

§ 9.8.6 If the Architect and Owner concur in the Contractor's assessment that the Work or a portion of the Work is safe to occupy, the Owner and Contractor may arrange for a Certificate of Occupancy inspection by OSE. The Owner, Architect, and Contractor shall be present at OSE's inspection. Upon verifying that the Work or a portion of the Work is substantially complete and safe to occupy, OSE will issue, as appropriate, a Full or Partial Certificate of Occupancy.

§ 9.8.7 The Owner may not occupy the Work until all required occupancy permits, if any, have been issued and delivered to the Owner.

§ 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.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 Final Completion and Final Payment

§ 9.10.1 Unless the parties agree otherwise in the Certificate of Substantial Completion, the Contractor shall achieve Final Completion within thirty days after Substantial Completion. 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, the Owner, and any other party the Architect or the Owner choose will make an inspection on a date and at a time mutually agreeable. 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.

.1 If more than one Final Completion inspection is required, the Contractor shall reimburse the Owner for all costs of re-inspections or, at the Owner's option, the costs may be deducted from payments due to the Contractor.

.2 If the Contractor does not achieve Final Completion within thirty days after Substantial Completion or the timeframe agreed to by the parties in the Certificate of Substantial Completion, whichever is

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greater, the Contractor shall be responsible for any additional Architectural fees resulting from the delay.

.3 If OSE has not previously issued a Certificate of Occupancy for the entire Project, the Parties shall arrange for a representative of OSE to participate in the Final Completion inspection.

§ 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,

.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,

.7 required Training Manuals,

.8 equipment Operations and Maintenance Manuals,

.9 any certificates of testing, inspection or approval required by the Contract Documents and not previously provided, and

10. one copy of the Documents required by Section 3.11.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is delayed 60 days 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 specific claims in stated amounts that have been previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

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

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.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.

§ 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.

§ 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 which was not discoverable as provided in Section 3.2.1 and not addressed in the Contract Documents, and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons or serious loss to real or personal property resulting from such a material or substance 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. Hazardous materials or substances are those hazardous, toxic, or radioactive materials or substances subject to regulations by applicable governmental authorities having jurisdiction, such as, but not limited to, the S.C. Department of Health and Environmental Control, the U.S. Environmental Protection Agency, and the U.S. Nuclear Regulatory Commission.

§ 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

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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. In the absence of agreement, the Architect will make an interim determination regarding any delay or impact on the Contractor's additional costs. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the rights of either party to disagree and assert a Claim in accordance with Article 15.

§ 10.3.3 The Work in the affected area shall be resumed immediately following the occurrence of any one of the following events: (a) the Owner causes remedial work to be performed that results in the absence of hazardous materials or substances; (b) the Owner and the Contractor, by written agreement, decide to resume performance of the Work; or (c) the Work may safely and lawfully proceed, as determined by an appropriate governmental authority or as evidenced by a written report to both the Owner and the Contractor, which is prepared by an environmental engineer reasonably satisfactory to both the Owner and the Contractor.

§ 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.

§ 10.3.5 In addition to its obligations under Section 3.18, 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 Reserved

§ 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. The Contractor shall immediately give the Owner and Architect notice of the emergency. This initial notice may be oral followed within five (5) days by a written notice setting forth the nature and scope of the emergency. Within fourteen (14) days of the start of the emergency, the Contractor shall give the Architect a written estimate of the cost and probable effect of delay on the progress of the Work.

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, 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.

§ 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.

§ 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 Failure to Purchase Required Property Insurance. If the Contractor 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

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Contract Documents, the Contractor shall inform the Owner in writing prior to commencement of the Work. Upon receipt of notice from the Contractor, the Owner may delay commencement of the Work and may obtain insurance that will protect the interests of the Owner in the Work. When the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time shall not be equitably adjusted. In the event the Contractor fails to procure coverage, the Contractor waives all rights against the Owner to the extent the loss to the Contractor (including Subcontractors and Sub-subcontractors) would have been covered by the insurance to have been procured by the Contractor. The cost of the insurance shall be charged to the Contractor by a Change Order. If the Contractor does not provide written notice, and the Owner is damaged by the failure or neglect of the Contractor to purchase or maintain the required insurance, the Contractor shall reimburse the Owner for all reasonable costs and damages attributable thereto.

§ 11.1.5 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 and all additional insureds of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Owner: (1) the Owner, upon receipt of notice from the Contractor, 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 not be equitably adjusted; and (3) the Contractor waives all rights against the Owner to the extent any loss to the Contractor, Subcontractors, and Sub-subcontractors would have been covered by the insurance had it not expired or been cancelled. If the Owner purchases replacement coverage, the cost of the insurance shall be charged to the Contractor by an appropriate Change Order. 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 Reserved

§ 11.2.3 Reserved

§ 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.

§ 11.3.3 Limitation on the Owner's Waiver of Subrogation

South Carolina law prohibits the State from indemnifying a private party. Accordingly, and notwithstanding anything in the Agreement to the contrary, including but not limited to Sections 11.3.1, 11.3.2. and 11.4, the Owner cannot and

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does not waive subrogation to the extent any losses are covered by insurance provided by the South Carolina Insurance Reserve Fund.

§ 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 Contractors as fiduciary and made payable to the Contractor 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 Contractor shall pay the Architect and Owner their just shares of insurance proceeds received by the Contractor, and by appropriate agreements the Architect and Owner shall make payments to their consultants and separate contractors in similar manner.

§ 11.5.2 Prior to settlement of an insured loss, the Contractor shall notify the Owner of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Owner shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the Owner does not object, the Contractor shall settle the loss and the Owner shall be bound by the settlement and allocation. Upon receipt, the Contractor 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 Owner timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Contractor 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.

§ 11.5.3 If required in writing by a party in interest, the Contractor as fiduciary shall, upon occurrence of an insured loss, give bond for proper performance of the Contractor's duties. The cost of required bonds shall be charged against proceeds received as fiduciary. The Contractor shall deposit in a separate account proceeds so received, which the Contractor shall distribute in accordance with such agreement as the parties in interest may reach. If after such loss no other special agreement is made and unless the Owner terminates the Contract for convenience, replacement of damaged property shall be performed by the Contractor.

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 requirements specifically expressed in the Contract Documents, including inspections of work-in-progress required by all authorities having jurisdiction over the Project, it must, upon demand of the Architect or authority having jurisdiction, be uncovered for observation/inspection 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 costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense unless the condition was caused by the Owner or a Separate Contractor in which event the Owner shall be responsible for payment of such costs.

§ 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.

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.1 If the Contractor, a Subcontractor, or anyone for whom either is responsible, uses or damages any portion of the Work, including, without limitation, mechanical, electrical, plumbing, and other building systems, machinery, equipment, or other mechanical device, the Contractor shall cause such item to be restored to "like new" condition at no expense to the Owner.

§ 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 an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor. 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.

§ 12.2.2.2 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.

§ 12.2.2.3 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 unless otherwise provided in the Contract Documents.

§ 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.

§ 12.3 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

§ 13.1.1 The Contract, any dispute, claim, or controversy relating to the Contract, and all the rights and obligations of the parties shall, in all respects, be interpreted, construed, enforced and governed by and under the laws of the State of South Carolina, except its choice of law rules.

§ 13.1.2 This Contract is formed pursuant to and governed by the South Carolina Consolidated Procurement Code and is deemed to incorporate all applicable provisions thereof and the ensuing regulations.

§ 13.2 Successors and Assigns

The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Neither party to the Contract shall assign the Contract as a whole, or in part, without written consent of the other and then only in accordance with and as permitted by Regulation 19-445.2180 of the South Carolina Code of Regulations, as amended. If either party attempts

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to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.3 Rights and Remedies

§ 13.3.1 Unless expressly provided otherwise, 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.

§ 13.3.3 Notwithstanding Section 9.10.4, the rights and obligations which, by their nature, would continue beyond the termination, cancellation, rejection, or expiration of this contract shall survive such termination, cancellation, rejection, or expiration, including, but not limited to, the rights and obligations created by the following clauses:

1.5 Ownership and Use of Drawings, Specifications and Other Instruments of Service;
3.5 Warranty
3.17 Royalties, Patents and Copyrights
3.18 Indemnification
7.5 Pricing Data and Audit
A.3.2.2 Contractor's Liability Insurance (A101, Exhibit A)
A.3.5 Performance and Payment Bond (A101, Exhibit A)
15.1.7 Claims for Listed Damages
15.1.8 Waiver of Claims Against the Architect
15.6 Dispute Resolution
15.6.5 Service of Process

§ 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 approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Owner and Architect timely notice of when and where tests and inspections are to be made so that they may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

.1 Inspection, Special Inspections, and testing requirements, if any, as required by the ICC series of Building Codes shall be purchased by the Owner.

.2 Contractor shall schedule and request inspections in an orderly and efficient manner and shall notify the Owner whenever the Contractor schedules an inspection. Contractor shall be responsible for the cost of inspections scheduled and conducted without the Owner's knowledge and for any increase in the cost of inspections resulting from the inefficient scheduling of inspections.

§ 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 Owner and 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 and shall be deducted from future Applications of Payment.

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§ 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.

§ 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 to the Contractor and unpaid under the Contract Documents shall bear interest only if and to the extent allowed by S.C. Code Ann. §§ 29-6-10 through 29-6-60. Amounts due to the Owner shall bear interest at the rate of one percent a month or a pro rata fraction thereof on the unpaid balance as may be due.

§ 13.6 Procurement of Materials by Owner

The Contractor accepts assignment of all purchase orders and other agreements for procurement of materials and equipment by the Owner that are identified as part of the Contract Documents. The Contractor shall, upon delivery, be responsible for the storage, protection, proper installation, and preservation of such Owner purchased items, if any, as if the Contractor were the original purchaser. The Contract Sum includes, without limitation, all costs and expenses in connection with delivery, storage, insurance, installation, and testing of items covered in any assigned purchase orders or agreements. Unless the Contract Documents specifically provide otherwise, all Contractor warranty of workmanship and correction of the Work obligations under the Contract Documents shall apply to the Contractor's installation of and modifications to any Owner purchased items.

§ 13.7 Interpretation of Building Codes

As required by S.C. Code Ann. § 10-1-180, OSE shall determine the enforcement and interpretation of all building codes and referenced standards on state buildings. The Contractor shall refer any questions, comments, or directives from local officials to the Owner and OSE for resolution.

§ 13.8 Minority Business Enterprises

Contractor shall notify Owner of each Minority Business Enterprise (MBE) providing labor, materials, equipment, or supplies to the Project under a contract with the Contractor. Contractor's notification shall be via the first monthly status report submitted to the Owner after execution of the contract with the MBE. For each such MBE, the Contractor shall provide the MBE's name, address, and telephone number, the nature of the work to be performed or materials or equipment to be supplied by the MBE, whether the MBE is certified by the South Carolina Office of Small and Minority Business Assistance, and the value of the contract.

§ 13.9 Illegal Immigration

Contractor certifies and agrees that it will comply with the applicable requirements of Title 8, Chapter 14 of the South Carolina Code of Laws and agrees to provide to the State upon request any documentation required to establish either: (a) that Title 8, Chapter 14 is inapplicable both to Contractor and its subcontractors or sub-subcontractors; or (b) that Contractor and its subcontractors or sub-subcontractors are in compliance with Title 8, Chapter 14. Pursuant to Section 8-14-60, "A person who knowingly makes or files any false, fictitious, or fraudulent document, statement, or report pursuant to this chapter is guilty of a felony and, upon conviction, must be fined within the discretion of the court or imprisoned for not more than five years, or both." Contractor agrees to include in any contracts with its subcontractor's language requiring its subcontractors to (a) comply with the applicable requirements of Title 8, Chapter 14, and (b) include in their contracts with the sub-subcontractor's language requiring the sub-subcontractors to comply with the applicable requirements of Title 8, Chapter 14. (An overview is available at www.procurement.sc.gov)

§ 13.10 Drug-Free Workplace

The Contractor must comply with the Drug-Free Workplace Act, S.C. Code Ann. §§ 44-107-10, et seq. The Contractor certifies to the Owner that Contractor will provide a Drug-Free Workplace, as defined by S.C. Code Ann. § 44-107-20(1).

§ 13.11 False Claims

According to S.C. Code Ann. § 16-13-240, "a person who by false pretense or representation obtains the signature of a person to a written instrument or obtains from another person any chattel, money, valuable security, or other property, real or personal, with intent to cheat and defraud a person of that property is guilty" of a crime.

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§ 13.12 Prohibited Acts

It is unlawful for a person charged with disbursements of state funds appropriated by the General Assembly to exceed the amounts and purposes stated in the appropriations. (§ 11-9-20) It is unlawful for an authorized public officer to enter into a contract for a purpose in which the sum is in excess of the amount appropriated for that purpose. It is unlawful for an authorized public officer to divert or appropriate the funds arising from any tax levied and collected for any one fiscal year to the payment of an indebtedness contracted or incurred for a previous year. (§ 11-1-40)

§ 13.13 Open Trade (Jun 2015)

During the contract term, including any renewals or extensions, Contractor will not engage in the boycott of a person or an entity based in or doing business with a jurisdiction with whom South Carolina can enjoy open trade, as defined in S.C. Code Ann. § 11-35-5300.

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 45 consecutive days 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, for any of the following reasons:

.1 Issuance of an order of a court or other public authority having jurisdiction that requires substantially all Work to be stopped; or

.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 and the Contractor has stopped work in accordance with Section 9.7.

§ 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, and costs incurred by reason of such termination.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees or any other persons or entities performing portions of the Work because the Owner has persistently failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 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, or otherwise fails to prosecute the Work, or any separable part of the Work, with the diligence, resources and skill that will ensure its completion within the time specified in the Contract Documents, including any authorized adjustments;

.2 fails to make payment to Subcontractors or suppliers in accordance with the Contract Documents and 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, 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:

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.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 Architect, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.2.5 If, after termination for cause, it is determined that the Owner lacked justification to terminate under Section 14.2.1, or that the Contractor's default was excusable, or that the termination for cause was affected by any other error, then Owner and Contractor agree that the termination shall be conclusively deemed to be one for the convenience of the Owner, and the rights and obligations of the parties shall be the same as if the termination had been issued for in Section 14.4.

§ 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. 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 in whole or in part for the Owner's convenience and without cause. The Owner shall give notice of the termination to the Contractor specifying the part of the Contract terminated and when termination becomes effective.

§ 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;
.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; and
.4 complete the performance of the Work not terminated, if any.

§ 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 any other adjustments otherwise set forth in the Agreement.

§ 14.4.4 Contractor's failure to include an appropriate termination for convenience clause in any subcontract shall not (i) affect the Owner's right to require the termination of a subcontract, or (ii) increase the obligation of the Owner beyond what it would have been if the subcontract had contained an appropriate clause.

§ 14.4.5 Upon written consent of the Contractor, the Owner may reinstate the terminated portion of this Contract in whole or in part by amending the notice of termination if it has been determined that:
.1 the termination was due to withdrawal of funding by the General Assembly, Governor, or State Fiscal Accountability Authority or the need to divert project funds to respond to an emergency as defined by Regulation 19-445.2110(B) of the South Carolina Code of Regulations, as amended;

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.2 funding for the reinstated portion of the Work has been restored;
.3 circumstances clearly indicate a requirement for the terminated Work; and
.4 reinstatement of the terminated work is advantageous 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. A voucher, invoice, payment application or other routine request for payment that is not in dispute when submitted is not a Claim under this definition. 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 Reserved

§ 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 Architect. Such notice shall include sufficient information to advise the Architect and other party of the circumstances giving rise to the Claim, the specific contractual adjustment or relief requested and the basis of such request. 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 except as stated for adverse weather days in Section 15.1.6.2. By failing to give written notice of a Claim within the time required by this Section, a party expressly waives its Claim.

§ 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 Architect is required.

§ 15.1.4 Continuing Contract Performance

§ 15.1.4.1 Pending final resolution of a Claim, including any administrative review allowed under Section 15.6, 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 Architect'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.

§ 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. Claims for an increase in the Contract Time shall be based on one additional calendar day for each full calendar day that the Contractor is prevented from working.

§ 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 Claims for adverse weather shall be based on actual weather conditions at the job site or other place of performance of the Work, as documented in the Contractor's job site log.

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.2 For the purpose of this Contract, a total of five (5) days per calendar month (non-cumulative) shall be anticipated as "adverse weather" at the job site, and such time will not be considered justification for an extension of time. If, in any month, adverse weather develops beyond the five (5) days, the Contractor shall be allowed to claim additional days to compensate for the excess weather delays only to the extent of the impact on the approved construction schedule and days the Contractor was already scheduled to work. The remedy for this condition is for an extension of time only and is exclusive of all other rights and remedies available under the Contract Documents or imposed or available by law.

.3 The Contractor shall submit monthly with their pay application all Claims for adverse weather conditions that occurred during the previous month. The Architect shall review each monthly submittal in accordance with Section 15.5 and inform the Contractor and the Owner promptly of its evaluation. Approved days shall be included in the next Change Order issued by the Architect. Adverse weather conditions not claimed within the time limits of this Subparagraph shall be considered to be waived by the Contractor. Claims will not be allowed for adverse weather days that occur after the scheduled (original or adjusted) date of Substantial Completion.

§ 15.1.6.3 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.

§ 15.1.6.4 The Contractor shall not be entitled to a separate increase in the Contract Time for each one of the number of causes of delay which may have concurrent or interrelated effects on the progress of the Work, or for concurrent delays due to the fault of the Contractor.

§ 15.1.7 Claims for Listed Damages

Notwithstanding any other provision of the Contract Documents, including Section 1.2.1, but subject to a duty of good faith and fair dealing, the Contractor and Owner waive Claims against each other for listed damages arising out of or relating to this Contract.

§ 15.1.7.1 For the Owner, listed damages are (i) lost revenue and profit, (ii) losses resulting from injury to business or reputation, (iii) additional or escalated overhead and administration expenses, (iv) additional financing costs, (v) costs suffered by a third party unable to commence work, (vi) attorney's fees, (vii) any interest, except to the extent allowed by Section 13.5 (Interest), (viii) lost revenue and profit for lost use of the property, (ix) costs resulting from lost productivity or efficiency.

§ 15.1.7.2 For the Contractor, listed damages are (i) lost revenue and profit, (ii) losses resulting from injury to business or reputation, (iii) additional or escalated overhead and administration expenses, (iv) additional financing costs, (v) attorney's fees, (vi) any interest, except to the extent allowed by Section 13.5 (Interest); (vii) unamortized equipment costs; and, (viii) losses incurred by subcontractors for the types of damages the Contractor has waive as against the Owner. Without limitation, this mutual waiver is applicable to all damages due to either party's termination in accordance with Article 14.

§ 15.1.7.3 Nothing contained in this Section shall be deemed to preclude an award of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents. This mutual waiver is not applicable to amounts due or obligations under Section 3.18 (Indemnification).

§ 15.1.8 Waiver of Claims Against the Architect

Notwithstanding any other provision of the Contract Documents, including Section 1.2.1, but subject to a duty of good faith and fair dealing, the Contractor waives all claims against the Architect and any other design professionals who provide design and/or project management services to the Owner, either directly or as independent contractors or subcontractors to the Architect, for listed damages arising out of or relating to this Contract. The listed damages are (i) lost revenue and profit, (ii) losses resulting from injury to business or reputation, (iii) additional or escalated overhead and administration expenses, (iv) additional financing costs, (v) attorney's fees, (vi) any interest; (vii) unamortized equipment costs; and, (viii) losses incurred by subcontractors for the types of damages the Contractor has waive as against the Owner. This mutual waiver is not applicable to amounts due or obligations under Section 3.18 (Indemnification).

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§ 15.2 Reserved

§ 15.3 Reserved

§ 15.4 Reserved

§ 15.5 Claim and Disputes - Duty of Cooperation, Notice, and Architects Initial Decision

§ 15.5.1 Contractor and Owner are fully committed to working with each other throughout the Project to avoid or minimize Claims. To further this goal, Contractor and Owner agree to communicate regularly with each other and the Architect at all times notifying one another as soon as reasonably possible of any issue that if not addressed may cause loss, delay, and/or disruption of the Work. If Claims do arise, Contractor and Owner each commit to resolving such Claims in an amicable, professional, and expeditious manner to avoid unnecessary losses, delays, and disruptions to the Work.

§ 15.5.2 Claims shall first be referred to the Architect for initial decision. An initial decision shall be required as a condition precedent to resolution pursuant to Section 15.6 of any Claim arising prior to the date of final payment, unless 30 days have passed after the Claim has been referred to the Architect with no decision having been rendered, or after all the Architect's requests for additional supporting data have been answered, whichever is later. The Architect will not address Claims between the Contractor and persons or entities other than the Owner.

§ 15.5.3 The Architect will review Claims and within ten days of the receipt of a Claim (1) request additional supporting data from the claimant or a response with supporting data from the other party or (2) render an initial decision in accordance with Section 15.5.5.

§ 15.5.4 If the Architect 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 such request, and shall either (1) provide a response on the requested supporting data, (2) advise the Architect when the response or supporting data will be furnished or (3) advise the Architect that all supporting data has already been provided. Upon receipt of the response or supporting data, the Architect will render an initial decision in accordance with Section 15.5.5.

§ 15.5.5 The Architect will render an initial decision in writing; (1) stating the reasons therefor; and (2) notifying the parties of any change in the Contract Sum or Contract Time or both. The Architect will deliver the initial decision to the parties within two weeks of receipt of any response or supporting data requested pursuant to Section 16.4 or within such longer period as may be mutually agreeable to the parties. If the parties accept the initial decision, the Architect shall prepare a Change Order with appropriate supporting documentation for the review and approval of the parties and the Office of State Engineer. If either the Contractor, Owner, or both, disagree with the initial decision, the Contractor and Owner shall proceed with dispute resolution in accordance with the provisions of Section 15.6.

§ 15.5.6 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.

§ 15.6 Dispute Resolution

§ 15.6.1 If a Claim is not resolved pursuant to Section 15.5 to the satisfaction of either party, both parties shall attempt to resolve the dispute at the field level through discussions between Contractor's Representative and Owner's Representative. If a dispute cannot be resolved through Contractor's Representative and Owner's Representative, then the Contractor's Senior Representative and the Owner's Senior Representative, upon the request of either party, shall meet as soon as conveniently possible, but in no case later than twenty-one (21) days after such a request is made, to attempt to resolve such dispute. Prior to any meetings between the Senior Representatives, the parties will exchange relevant information that will assist the parties in resolving their dispute. The meetings required by this Section are a condition precedent to resolution pursuant to Section 15.6.2.

§ 15.6.2 If after meeting in accordance with the provisions of Section 15.6.1, the Senior Representatives determine that the dispute cannot be resolved on terms satisfactory to both the Contractor and the Owner, then either party may submit the dispute by written request to South Carolina's Chief Procurement Officer for Construction (CPOC). Except as otherwise provided in Article 15, all Claims, or controversies relating to the Contract shall be resolved exclusively by the appropriate Chief Procurement Officer in accordance with Title 11, Chapter 35, Article 17 of the

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South Carolina Code of Laws, or in the absence of jurisdiction, only in the Court of Common Pleas for, or in the absence of jurisdiction a federal court located in, Richland County, State of South Carolina. Contractor agrees that any act by the State regarding the Contract is not a waiver of either the State's sovereign immunity or the State's immunity under the Eleventh Amendment of the United States Constitution.

§ 15.6.3 If any party seeks resolution to a dispute pursuant to Section 15.6.2, the parties shall participate in non-binding mediation to resolve the Claim. If the Claim is governed by Title 11, Chapter 35, Article 17 of the South Carolina Code of Laws as amended and the amount in controversy is $100,000.00 or less, the CPOC shall appoint a mediator, otherwise, the mediation shall be conducted by an impartial mediator selected by mutual agreement of the parties, or if the parties cannot so agree, a mediator designated by the American Arbitration Association ("AAA") pursuant to its Construction Industry Mediation Rules. The mediation will be governed by and conducted pursuant to a mediation agreement negotiated by the parties or, if the parties cannot so agree, by procedures established by the mediator.

§ 15.6.4 Without relieving any party from the other requirements of Sections 15.5 and 15.6, either party may initiate proceedings in the appropriate forum prior to initiating or completing the procedures required by Sections 15.5 and 15.6 if such action is necessary to preserve a claim by avoiding the application of any applicable statutory period of limitation or repose.

§ 15.6.5 Service of Process

Contractor consents that any papers, notices, or process necessary or proper for the initiation or continuation of any Claims, or controversies relating to the Contract; for any court action in connection therewith; or for the entry of judgment on any award made, may be served on Contractor by certified mail (return receipt requested) addressed to Contractor at the address provided for the Contractor's Senior Representative or by personal service or by any other manner that is permitted by law, in or outside South Carolina. Notice by certified mail is deemed duly given upon deposit in the United States mail.

ARTICLE 16 PROJECT-SPECIFIC REQUIREMENTS AND INFORMATION

None

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SE-355
PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS, that *(Insert full name or legal title and address of Contractor)*

Name: _____

Address: _____

_____

hereinafter referred to as "Contractor", and *(Insert full name and address of principal place of business of Surety)*

Name: _____

Address: _____

_____

hereinafter called the "surety", are jointly and severally held and firmly bound unto *(Insert full name and address of Agency)*

Name: Spartanburg Community College

Address: 136 Community College Drive

Spartanburg, SC 29303

hereinafter referred to as "Agency", or its successors or assigns, the sum of _____ ($), being the sum of the Bond to which payment to be well and truly made, the Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, Contractor has by written agreement dated _____ entered into a contract with Agency to construct

State Project Name: Tyger River Building Cosmetology Renovation

State Project Number: H59-N306-JM

Brief Description of Awarded Work: Renovation of approximately 14,000SF with limited space reconfiguration for cosmetology to include 40 styling stations, 4 hair washing stations, manicure stations, pedicure stations and two academic classrooms. In addition to the Project includes the renovation of upper level restrooms, new finishes, lighting, and HVAC throughout the second floor.

in accordance with Drawings and Specifications prepared by *(Insert full name and address of A/E)*

Name: Moseley Architects

Address: 6210 Ardrey Kell Road, Suite 425

Charlotte, NC 28277

which agreement is by reference made a part hereof, and is hereinafter referred to as the Contract.

IN WITNESS WHEREOF, Surety and Contractor, intending to be legally bound hereby, subject to the terms stated herein, do each cause this Performance Bond to be duly executed on its behalf by its authorized officer, agent or representative.

DATED this _____ day of _____, 2_____
(shall be no earlier than Date of Contract)

BOND NUMBER _____

CONTRACTOR	**SURETY**
By: _____ **(Seal)**	**By:** _____ **(Seal)**
Print Name: _____	**Print Name:** _____
Print Title: _____	**Print Title:** _____ *(Attach Power of Attorney)*
Witness: _____	**Witness:** _____

(Additional Signatures, if any, appear on attached page)

SE-355
PERFORMANCE BOND

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH THAT:

1. The Contractor and the Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Agency for the full and faithful performance of the contract, which is incorporated herein by reference.

2. If the Contractor performs the contract, the Surety and the Contractor have no obligation under this Bond, except to participate in conferences as provided in paragraph 3.1.

3. The Surety's obligation under this Bond shall arise after:

3.1 The Agency has notified the Contractor and the Surety at the address described in paragraph 10 below, that the Agency is considering declaring a Contractor Default and has requested and attempted to arrange a conference with the Contractor and the Surety to be held not later than 15 days after receipt of such notice to discuss methods of performing the Contract. If the Agency, the Contractor and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Contract, but such an agreement shall not waive the Agency's right, if any, subsequently to declare a Contractor Default; or

3.2 The Agency has declared a Contractor Default and formally terminated the Contractor's right to complete the Contract.

4. The Surety shall, within 15 days after receipt of notice of the Agency's declaration of a Contractor Default, and at the Surety's sole expense, take one of the following actions:

4.1 Arrange for the Contractor, with consent of the Agency, to perform and complete the Contract; or

4.2 Undertake to perform and complete the Contract itself, through its agents or through independent contractors; or

4.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Agency for a contract for performance and completion of the Contract, arrange for a contract to be prepared for execution by the Agency and the contractor selected with the Agency's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the Bonds issued on the Contract, and pay to the Agency the amount of damages as described in paragraph 7 in excess of the Balance of the Contract Sum incurred by the Agency resulting from the Contractor Default; or

4.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and:

4.4.1 After investigation, determine the amount for which it may be liable to the Agency and, within 60 days of waiving its rights under this paragraph, tender payment thereof to the Agency; or

4.4.2 Deny liability in whole or in part and notify the Agency, citing the reasons therefore.

5. Provided Surety has proceeded under paragraphs 4.1, 4.2, or 4.3, the Agency shall pay the Balance of the Contract Sum to either:

5.1 Surety in accordance with the terms of the Contract; or

5.2 Another contractor selected pursuant to paragraph 4.3 to perform the Contract.

5.3 The balance of the Contract Sum due either the Surety or another contractor shall be reduced by the amount of damages as described in paragraph 7.

6. If the Surety does not proceed as provided in paragraph 4 with reasonable promptness, the Surety shall be deemed to be in default on this Bond 15 days after receipt of written notice from the Agency to the Surety demanding that the Surety perform its obligations under this Bond, and the Agency shall be entitled to enforce any remedy available to the Agency.

6.1 If the Surety proceeds as provided in paragraph 4.4 and the Agency refuses the payment tendered or the Surety has denied liability, in whole or in part, then without further notice the Agency shall be entitled to enforce any remedy available to the Agency.

6.2 Any dispute, suit, action or proceeding arising out of or relating to this Bond shall be governed by the Dispute Resolution process defined in the Contract Documents and the laws of the State of South Carolina.

7. After the Agency has terminated the Contractor's right to complete the Contract, and if the Surety elects to act under paragraph 4.1, 4.2, or 4.3 above, then the responsibilities of the Surety to the Agency shall be those of the Contractor under the Contract, and the responsibilities of the Agency to the Surety shall those of the Agency under the Contract. To a limit of the amount of this Bond, but subject to commitment by the Agency of the Balance of the Contract Sum to mitigation of costs and damages on the Contract, the Surety is obligated to the Agency without duplication for:

7.1 The responsibilities of the Contractor for correction of defective Work and completion of the Contract; and

7.2 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 paragraph 4; and

7.3 Damages awarded pursuant to the Dispute Resolution Provisions of the Contract. Surety may join in any Dispute Resolution proceeding brought under the Contract and shall be bound by the results thereof; and

7.4 Liquidated Damages, or if no Liquidated Damages are specified in the Contract, actual damages caused by delayed performance or non-performance of the Contractor.

8. The Surety shall not be liable to the Agency or others for obligations of the Contractor that are unrelated to the Contract, and the Balance of the Contract Sum 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 Agency or its heirs, executors, administrators, or successors.

9. The Surety hereby waives notice of any change, including changes of time, to the contract or to related subcontracts, purchase orders and other obligations.

10. Notice to the Surety, the Agency or the Contractor shall be mailed or delivered to the address shown on the signature page.

11. Definitions

11.1 Balance of the Contract Sum: The total amount payable by the Agency to the Contractor under the Contract after all proper adjustments have been made, including allowance to the Contractor of any amounts to be received by the Agency in settlement of insurance or other Claims for damages to which the Contractor si entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Contract.

11.2 Contractor Default: Failure of the Contractor, which has neither been remedied nor waived, to perform the Contract or otherwise to comply with the terms of the Contract.

SE-357
LABOR & MATERIAL PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS, that *(Insert full name or legal title and address of Contractor)*

Name: _____

Address: _____

_____

hereinafter referred to as "Contractor", and *(Insert full name and address of principal place of business of Surety)*

Name: _____

Address: _____

_____

hereinafter called the "surety", are jointly and severally held and firmly bound unto *(Insert full name and address of Agency)*

Name: Spartanburg Community College

Address: 136 Community College Drive

Spartanburg, SC 29303

hereinafter referred to as "Agency", or its successors or assigns, the sum of _____ ($), being the sum of the Bond to which payment to be well and truly made, the Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, Contractor has by written agreement dated _____ entered into a contract with Agency to construct

State Project Name: Tyger River Building Cosmetology Renovation

State Project Number: H59-N306-JM

Brief Description of Awarded Work: Renovation of approximately 14,000SF with limited space reconfiguration for cosmetology to include 40 styling stations, 4 hair washing stations, manicure stations, pedicure stations and two academic classrooms. In addition to the Project includes the renovation of upper level restrooms, new finishes, lighting, and HVAC throughout the second floor.

in accordance with Drawings and Specifications prepared by *(Insert full name and address of A/E)*

Name: Moseley Architects

Address: 6210 Ardrey Kell Road, Suite 425

Charlotte, NC 28277

which agreement is by reference made a part hereof, and is hereinafter referred to as the Contract.

IN WITNESS WHEREOF, Surety and Contractor, intending to be legally bound hereby, subject to the terms stated herein, do each cause this Labor & Material Payment Bond to be duly executed on its behalf by its authorized officer, agent or representative.

DATED this _____ **day of** _____**, 2**_____ **BOND NUMBER** _____

(shall be no earlier than Date of Contract)

CONTRACTOR	**SURETY**
By: _____ **(Seal)**	**By:** _____ **(Seal)**
Print Name: _____	**Print Name:** _____
Print Title: _____	**Print Title:** _____ *(Attach Power of Attorney)*
Witness: _____	**Witness:** _____

(Additional Signatures, if any, appear on attached page)

SE-357
LABOR & MATERIAL PAYMENT BOND

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH THAT:

1. The Contractor and the Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Agency to pay for all labor, materials and equipment required for use in the performance of the Contract, which is incorporated herein by reference.

2. With respect to the Agency, this obligation shall be null and void if the Contractor:

2.1 Promptly makes payment, directly or indirectly, for all sums due Claimants; and

2.2 Defends, indemnifies and holds harmless the Agency from all claims, demands, liens or suits by any person or entity who furnished labor, materials or equipment for use in the performance of the Contract.

3. With respect to Claimants, this obligation shall be null and void if the Contractor promptly makes payment, directly or indirectly, for all sums due.

4. With respect to Claimants, and subject to the provisions of Title 29, Chapter 5 and the provisions of §11-35-3030(2)(c) of the SC Code of Laws, as amended, the Surety's obligation under this Bond shall arise as follows:

4.1 Every person who has furnished labor, material or rental equipment to the Contractor or its subcontractors for the work specified in the Contract, and who has not been paid in full therefore before the expiration of a period of ninety (90) days after the date on which the last of the labor was done or performed by him or material or rental equipment was furnished or supplied by him for which such claim is made, shall have the right to sue on the payment bond for the amount, or the balance thereof, unpaid at the time of institution of such suit and to prosecute such action for the sum or sums justly due him.

4.2 A remote claimant shall have a right of action on the payment bond upon giving written notice by certified or registered mail to the Contractor within ninety (90) days from the date on which such person did or performed the last of the labor or furnished or supplied the last of the material or rental equipment upon which such claim is made.

4.3 Every suit instituted upon a payment bond shall be brought in a court of competent jurisdiction for the county or circuit in which the construction contract was to be performed, but no such suit shall be commenced after the expiration of o ne year after the day on which the last of the labor was performed or material or rental equipment was supplied by the person bringing suit.

5. When the Claimant has satisfied the conditions of paragraph 4, the Surety shall promptly and at the Surety's expense take the following actions:

5.1 Send an answer to the Claimant, with a copy to the Agency, within sixty (60) days after receipt of the claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed.

5.2 Pay or arrange for payment of any undisputed amounts.

5.3 The Surety's failure to discharge its obligations under this paragraph 5 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a claim. However, if the Surety fails to discharge its obligations under this paragraph 5, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs to recover any sums found to be due and owing to the Claimant.

6. Amounts owed by the Agency to the Contractor under the Contract shall be used for the performance of the Contract and to satisfy claims, if any, under any Performance Bond. By the Contractor furnishing and the Agency accepting this Bond, they agree that all funds earned by the contractor in the performance of the Contract are dedicated to satisfy obligations of the Contractor and the Surety under this Bond, subject to the Agency's prior right to use the funds for the completion of the Work.

7. The Surety shall not be liable to the Agency, Claimants or others for obligations of the Contractor that are unrelated to the Contract. The Agency shall not be liable for payment of any costs or expenses of any claimant under this bond, and shall have under this Bond no obligations to make payments to, give notices on behalf of, or otherwise have obligations to Claimants under this Bond.

8. The Surety hereby waives notice of any change, including changes of time, to the Contract or to related Subcontracts, purchase orders and other obligations.

9. Notice to the Surety, the Agency or the Contractor shall be mailed or delivered to the addresses shown on the signature page. Actual receipt of notice by Surety, the Agency or the contractor, however accomplished, shall be sufficient compliance as of the date received at the address shown on the signature page.

10. By the Contractor furnishing and the Agency accepting this Bond, they agree that this Bond has been furnished to comply with the statutory requirements of the South Carolina Code of Laws, as amended, and further, that any provision in this Bond conflicting with said statutory requirements shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory Bond and not as a common law bond.

11. Upon request of any person or entity appearing to be a potential beneficiary of this bond, the Contractor shall promptly furnish a copy of this Bond or shall permit a copy to be made.

12. Any dispute, suit, action or proceeding arising out of or relating to this Bond shall be governed by the laws of the State of South Carolina.

13. **DEFINITIONS**

13.1 Claimant: An individual or entity having a direct contract with the Contractor or with a Subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Contract. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the Contract, architectural and engineering services required for performance of the Work of the Contractor and the Contractor's Subcontractors, and all other items for which a mechanic's lien might otherwise be asserted.

13.2 Remote Claimant: A person having a direct contractual relationship with a subcontractor of the Contractor or subcontractor, but no contractual relationship expressed or implied with the Contractor.

13.3 Contract: The agreement between the Agency and the Contractor identified on the signature page, including all Contract Documents and changes thereto.

SE-380 **CHANGE ORDER NO.:**_____

CHANGE ORDER TO DESIGN-BID-BUILD CONTRACT

AGENCY: Spartanburg Community College

PROJECT NAME: Tyger River Building Cosmetology Renovation

PROJECT NUMBER: H59-N306-JM

CONTRACTOR: _____

This Contract is changed as follows: *(Insert description of change in space provided below.)*

ADJUSTMENTS IN THE CONTRACT SUM:

1.	**Original Contract Sum:**		$
2.	**Change in Contract Sum by previously approved Change Orders:**		
3.	**Contract Sum prior to this Change Order:**		$ 0.00
4.	**Amount of this Change Order:**		
5.	**New Contract Sum, including this Change Order:**		$ 0.00

ADJUSTMENTS IN THE CONTRACT TIME:

1.	**Initial Date for Substantial Completion:**		
2.	**Sum of previously approved increases and decreases in Days:**		Days
3.	**Change in Days for this Change Order:**		Days
4.	**Total Number of Days added to this Contract including this Change Order:**	0 Days	
5.	**New Date for Substantial Completion:**		

AGENCY ACCEPTANCE AND CERTIFICATION:

I certify that the Agency has authorized, unencumbered funds available for obligation to this contract.

BY:_____ **Date:**_____

(Signature of Representative)

Print Name of Representative:_____

Change is within Agency Construction Contract Change Order Certification of: **$**_____ **Yes** ☐ **No** ☐

APPROVED BY:_____ **DATE:** _____

(OSE Project Manager)

SUBMIT THE FOLLOWING TO OSE

1. SE-380, completed and signed by the Agency.
2. SE-380, Page 2, completed and signed by the Contractor, A/E and Agency, with back-up information to support request.

SE-380, Page 2 **CHANGE ORDER REQUEST NO.:**_____

CHANGE ORDER REQUEST SUMMARY – DESIGN-BID-BUILD

AGENCY: Spartanburg Community College

PROJECT NAME: Tyger River Building Cosmetology Renovation

PROJECT NUMBER: H59-N306-JM

CONTRACTOR: _____

This Contract is requested to be changed as follows: *(Insert description of change in space provided below.)*

ADJUSTMENTS IN THE CONTRACT TIME: Requested Change in Days for this Change Order:_____ Days

			(1) Contractor	(2) Subcontractor	(3) TOTAL
Direct Costs (Provide back-up, including hourly rates, invoices, manhours, etc.)	**1.**	Labor			
	2.	Materials (including Sales Tax)			
	3.	Rental Charges			
	4.	Subtotal Direct Costs (sum lines 1 – 3)	**$ 0.00**	**$ 0.00**	**$ 0.00**
Contractor Markup (per AIA A201, Section 7.1.5)	**5.**	Contractor OH&P (not to exceed 17% of line 4, col 1)			
	6.	Subcontractor's OH&P (not to exceed 17% of line 4, col 2)			
	7.	Contractor markup on Subcontractor (not to exceed 10% of line 4, col 2)			
	8.	Total Contractor Markup (sum lines 5 – 7)	**$ 0.00**	**$ 0.00**	**$ 0.00**
Additional Bonding, Insurance and Permit Costs Associated with Change Order	**9.**	Bonds			
	10.	Insurance			
	11.	Permits, Licenses or Fees			
	12.	Subtotal (sum lines 9 – 11)	**$ 0.00**	**$ 0.00**	**$ 0.00**
TOTAL	**13.**	Change Order Cost (sum lines 4, 8, 12, col 3)			**$ 0.00**

ADJUSTMENTS IN THE CONTRACT SUM: Amount of this Change Order Request: **$**_____

CONTRACTOR ACCEPTANCE:

BY:_____ **Date:**_____
(Signature of Representative)

Print Name of Representative:_____

A/E RECOMMENDATION FOR ACCEPTANCE:

BY:_____ **Date:**_____
(Signature of Representative)

Print Name of Representative:_____

AGENCY ACCEPTANCE:

BY:_____ **Date:**_____
(Signature of Representative)

Print Name of Representative:_____

Instruction to Contractor: Attach documentation as needed to justify the requested change to the contract and submit to A/E or Agency.

SECTION 011000
SUMMARY

PART 1 GENERAL

1.01 PROJECT

A. Project Name: Tyger River Building Cosmetology Renovation.

B. Owner's Name: Spartanburg Community College.

C. Architect's Name: Moseley Architects of Richmond, VA.

D. South Carolina Office of State Engineer (OSE) Project No.: H59-N306-JM.

1.02 CONTRACT DESCRIPTION

A. Contract Type: A single prime contract based on a Stipulated Price (Fixed Sum) as described in the Bidding and Contractual Requirements (Division 00) included in this Project Manual.

1.03 PROFESSIONAL SEALS

A. Use of Professional Seals on Bidding, Procurement, and Contract Documents: For the purposes of this paragraph, the term “Regulant” refers to the individual who signs and seals parts of the Contract Documents (e.g. the Drawings and Specifications). Certain information has been excerpted verbatim from a source or sources (e.g., UL assemblies, SMACNA details, applicable state/jurisdiction building code) which was considered or used by Regulant in preparing parts of the Contract Documents, as follows:

1. The excerpted information was neither prepared under the direct control nor personal supervision nor created by the Regulant, as it was prepared by the source and owner of the excerpted information.
2. For purposes of bidding, procuring, and performance of the Work, and in any event of conflicts or ambiguities between the excerpted information in the Contract Documents and the requirements of applicable codes and standards, provide the better quality or greater quantity of Work which, at a minimum, complies with the requirements of the applicable codes and standards.
3. Advise Architect immediately upon becoming aware of requirements of the Work which are not consistent with the requirements of the excerpted information.
4. Attribution is acknowledged for information obtained and included herein verbatim from other source or sources.
5. Regulant has taken into consideration and used certain excerpted information from other sources which are applicable to the Contract Documents, and the Regulant indicates by its seal that it is assuming responsibility for its services in use and application of the excerpted information to the requirements of Work, but not for the excerpted information itself which was prepared by others. Regulant does not indicate by its seal that it is responsible for use or application of other information in such source or sources which was not included herein.

1.04 WORK BY OWNER

A. Owner-Furnished/Contractor-Installed Products: Refer to Section 016000 - Product Requirements for additional requirements. Owner will furnish the following for installation by Contractor (OF/CI):

1. Indicated toilet accessories.

B. Owner-Furnished/Owner-Installed Products: Some items noted NIC (Not in Contract) or OF/OI will be furnished and installed by the Owner before the Date of Substantial Completion. Items include, but are not limited to, the following:
   1. Educational white boards with projector.
   2. Classroom clocks.
   3. Wireless Access Points
   4. Security Cameras

1.05 OWNER OCCUPANCY

A. Owner intends to continue to occupy adjacent portions of the existing building during the entire construction period.

B. Owner intends to occupy the Project upon Substantial Completion.

C. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.

D. Schedule the Work to accommodate Owner occupancy.
   1. Maintain routes of egress and life safety systems for Owner and occupants at all times.

1.06 CONTRACTOR USE OF SITE AND PREMISES

A. Construction Operations: Limited to areas noted on Drawings.
   1. Locate and conduct construction activities in ways that will limit disturbance to site.

B. Provide access to and from site as required by law and by Owner:
   1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
   2. Do not obstruct roadways, sidewalks, or other public ways without permit.

C. Existing building spaces may not be used for storage.

D. Existing building shall be maintained weathertight. Do not modify elements of the existing building except as indicated on the Construction Documents. Repair damage to the existing building due to construction activity.

E. Time Restrictions:
   1. Comply with local regulations for hours of work, noise ordinances, and similar requirements.

F. Utility Outages and Shutdown:
   1. Limit disruption of utility services to hours the building is unoccupied.
   2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to Owner and authorities having jurisdiction.
   3. Prevent accidental disruption of utility services to other facilities.

G. Controlled Substances: The use of alcohol and drugs is not permitted on the Project site. Provide a designated outdoor smoking area for construction personnel that is at least 30 feet away from the building.

1.07 SPECIFICATION SECTIONS APPLICABLE TO ALL WORK

A. The provisions of the Owner/Contractor agreement, General Conditions of the Contract, Supplementary Conditions (if any), and all Division 01 sections shall apply to all sections of the Project Manual.

1.08 SECURITY PROVISIONS

A. Background Check: The Owner requires that a background check be performed on all personnel working on the site. Comply with Owner's requirements for screening service to be used. Maintain a list of all accredited persons, submit a copy to Owner on request.

B. Identification Badges: Provide identification badges to each person authorized to enter premises. Badge shall include personal photograph, name, employer, expiration date, and an assigned number. Have personnel return badges to Contractor after completion of their portion of the Work.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 011000

SECTION 012000
PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SCHEDULE OF VALUES

A. Use Schedule of Values Form: AIA G703, unless otherwise agreed to by Owner in writing.

B. Forms filled out by hand will not be accepted.

C. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification section. Identify site mobilization.

D. Include in each line item, the amount of Allowances specified in this section. For Quantity Allowances, identify quantities taken from Contract Documents multiplied by the unit cost to achieve the total for the item.

E. Include separately from each line item, a direct proportional amount of Contractor's overhead and profit.

F. Revise schedule to list approved Change Orders, with each Application For Payment.
   1. When a Change Order includes multiple PCOs, break down the total Change Order to include each PCO as an individual line item.

1.02 APPLICATIONS FOR PROGRESS PAYMENTS

A. Payment Period: Submit at intervals stipulated in the Agreement.

B. Use Form AIA G702 and Form AIA G703.

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. For each item, provide a column for listing each of the following:
   1. Item Number.
   2. Description of work.
   3. Scheduled Values.
   4. Previous Applications.
   5. Work in Place and Stored Materials under this Application.
   6. Authorized Change Orders.
   7. Total Completed and Stored to Date of Application.
   8. Balance to Finish.
   9. Retainage.

F. Execute certification by signature of authorized officer.

G. 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.

H. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.
   1. When a Change Order includes multiple PCOs, break down the total Change Order to include each PCO as an individual line item.

I. Submit one electronic and three hard-copies of each Application for Payment.

J. Include the following with the application:
   1. Transmittal letter as specified for submittals in Section 013000.
   2. Construction progress schedule, revised and current as specified in Section 013000.
   3. Partial release of liens from major subcontractors and vendors.
   4. Affidavits attesting to off-site stored products.

1.03 MODIFICATION PROCEDURES

A. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor on AIA Document G710 "Architect's Supplemental Instructions."

B. For changes for which advance pricing is desired, Architect will issue a 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 14 days, unless otherwise indicated in Proposal Request.

C. 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.

D. For other required changes, Architect will issue a Construction Change Directive, on AIA Document G714, 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.

E. 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.

F. 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.

G. Execution of Change Orders: Architect will issue Change Orders on AIA Document G701 for signatures of parties as provided in the Conditions of the Contract.

H. 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.

I. 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.

1.04 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 017000.

C. Provide evidence and supporting data for the following, as attachments to the Application for Final Payment:
   1. AIA G706, "Contractor's Affidavit of Payment of Debts and Claims."
   2. AIA G706A, "Contractor's Affidavit of Release of Liens."
   3. AIA G707, "Consent of Surety to Final Payment."
   4. Copy of Certificate of Occupancy.
   5. Settlement of all debts and claims, including liquidated damages, taxes, and fees.
   6. Utility meter readings, fuel levels, and similar measurements, as of the date of turn over to the Owner.
   7. Certificates for insured products, and certificate of insurance for completed operations.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 012000

SECTION 012300
ALTERNATES

PART 1 GENERAL

1.01 ACCEPTANCE OF ALTERNATES

A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.

B. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.

1.02 SCHEDULE OF ALTERNATES

A. Alternate No. 1:

1. Base Bid Item: No work in the lower level group restrooms, this includes no demoltion activities, no new construction activities, no in-kind fixture replacements, etc.
2. Alternate Item: Renovation of lower level group restrooms as indictaed on drawings A1.2.1 and A2.1.1.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 012300

SECTION 012500
SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 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, such as unavailability, regulatory changes, or unobtainable warranty terms.
   2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.

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. 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.

C. Substitutions shall be submitted directly by a General Contractor/prime bidder. Substitutions submitted by a subcontractor, manufacturer, supplier or other entity other than General Contractor are not acceptable and shall be rejected.

D. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
   1. A copy of the Substitution Request Form that shall be used is included at the end of this Section for informational purposes. Request a Word or editable PDF version of the form from the Architect and complete the form digitally; do not complete the form by hand.
   2. Contractor's Substitution Request documentation must include the following:
      a. Substitution Request Information:
         1) Indication of whether the substitution is for cause or convenience.
         2) Issue date.

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) Description of how proposed substitution affects other parts of work.

b. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing essential attributes specified, as appropriate and relevant for the item:
1) Physical characteristics.
2) In-service performance.
3) Expected durability.
4) Visual effect.
5) Sustainable design features.
6) Warranties.
7) Other salient features and requirements.
8) Include, as appropriate or requested, the following types of documentation:
(a) Product Data:
(b) Samples.
(c) Certificates, test, reports or similar qualification data.
(d) Drawings, when required to show impact on adjacent construction elements.

c. Impact of Substitution: Provide data indicating cost savings to Owner and change in Contract Time due to accepting substitution.

E. Limit each request to a single proposed substitution item.
1. Submit an electronic document, combining the request form with supporting data into single document.

3.02 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

A. Architect will consider requests for substitutions for convenience only within 30 days after date of Agreement.
1. Substitutions for convenience submitted after this time period may or may not be considered, at the Architect's discretion.

B. Submit request for Substitution for Cause immediately upon 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 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.

3.03 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.

3.04 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.

3.05 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals, for closeout submittals.

END OF SECTION 012500

MOSELEYARCHITECTS

Substitution Request Form – Prior to Receipt of Bids

General Information				
Project Name	Tyger River Building Cosmetology Renovation			
A/E Project Number	635251			
Specified Product/Item Information				
Specification Title				
Section				
Page				
Article / Paragraph				
Description				
Proposed Substitution Information				
Proposed Substitution				
Reason for not providing specified product/item				
Comparative Data	Attach a point-by-point comparative data list. Include all differences between the proposed substitution and the specified product/item. If not provided, this Request will be rejected.			
Manufacturer				
Manufacturer Address				
Manufacturer Phone				
Manufacturer Representative Email address				
Trade / Model Name				
Model Number				
Installer (if known)				
Installer Address				
Installer Phone				
History	☐ New product	☐ 2-5 years	☐ 5-10 yrs	☐ 10 yrs or longer
Proposed substitution affects other parts of the Work	☐ Yes		☐ No	
If yes, explain				
Proposed Substitution Similar Installation				
Have you used this product/item on any other projects	☐ Yes		☐ No	
Project				
Project Address				
Architect/Engineer				
A/E Phone				

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Owner	
Owner Phone	
Date installed	

Attached Supporting Data

☐ Drawings	☐ Product Data/Specs	☐ Samples	☐ Tests	☐ Reports	☐

Entity submitting this Substitution Request certifies all of the following:

- Proposed substitution has been fully investigated and determined to be equivalent or superior in all respects to the specified product, except as may otherwise be specifically and clearly indicated herein.
- If applicable, proposed substitution shall not adversely affect LEED requirements nor shall it prevent achieving the relative number of applicable LEED point[s] the specified product would have received.
- Proposed substitution's function, appearance, and quality are equal or superior in all respects to the specified product, except as may otherwise be specifically and clearly indicated herein.
- Same or superior warranty and/or guarantees shall be furnished for proposed substitution as is required for the specified product/item.
- Same maintenance service and source replacement parts, as applicable, are available; including local availability.
- Proposed substitution shall have no adverse effect on other trades.
- Proposed substitution shall not affect dimensions and functional clearances.
- Coordination, installation, and changes to the Work as necessary for the accepted proposed substitution shall be complete in all respects.

Entity's Information

Submitted by	
Signed By	
Date	
Email address of Signee above	
Company Name	
Address	
Phone	

Architect / Engineer Review and Action

If this Substitution request is acceptable, it shall be included in an Addendum. If the proposed substitution is not included in an Addendum, then the proposed substitution was rejected; was not submitted in accordance with the Bidding/Procurement Documents; and/or this Form was not complete. This Form shall be completely filled in to be considered for acceptance.

Acceptance of this Substitution request is an acceptance of the manufacturer and product/item only for general conformance with the design concept reflected in the Bidding/Procurement Documents. The A/E has made no attempt to verify specific performance data, or to check details of the proposed substitution as to special features, capacities, physical dimensions, or code and/or regulatory compliance – all of which remain the responsibility of the submitting entity and the Contractor (if not the submitting entity).

END OF SUBSTITUTION REQUEST FORM

SECTION 013000
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 GENERAL ADMINISTRATIVE REQUIREMENTS

A. Comply with requirements of Section 017000 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.

B. Electronic File Distribution: Upon request, Contractor may be provided electronic files for use in coordination of the Work and preparation of submittals. Contractor shall submit a signed Request Form for Electronic Files, provided by the Architect.

1. Electronic files do not contain all of the information of the Bid Documents or Contract Documents for construction of the Project, and the Architect shall not be responsible for differences between electronic files, Bid Documents, and Contract Documents.

1.02 SUBMITTALS

A. General Contractor Personnel: Within 15 days after award of Contract, provide a summary of General Contractor's on site personnel. Identify each individual, beginning with project superintendent. List project responsibilities, cell phone number, and email address.

B. Subcontractors: Within 15 days after award of Contract, provide a summary of all companies and individuals engaged as subcontractors for any part of the Project. Include a contact name, company address, phone number, and email address, and identify what part of the Work shall be completed by each subcontractor.

C. Coordination Drawings: Submit completed Coordination Drawings for Architect's information.

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, or MS Excel) 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 Interpretation (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. It is Contractor's responsibility to submit documents in allowable format.
3. Subcontractors, suppliers, and Architect's consultants will be permitted to use the service at no extra charge.
4. Paper document transmittals will not be reviewed unless previously approved; emailed electronic documents will not be reviewed.
5. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.

B. Submittal Service: Coordinate method for exchanging files no later than the Preconstruction Meeting. The Architect's Procore service and procedures can be used at no charge. If the Contractor chooses to use a different platform and methodology:
   1. The Architect may reject the methodology or platform proposed and:
      a. use the Architect's Procore service, or
      b. the project team will revert to traditional hard-copy exchange;
   2. or the Contractor shall bear the cost of software, licensing, training, etc., for the project team to participate.

C. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive/record copies of files for Owner. If the Project Team uses an alternate platform preferred by the Contractor, the Contractor shall be responsible for distributing archive/record copies of files to Owner and Architect.

3.02 PRECONSTRUCTION MEETING

A. Architect will schedule a meeting after Notice of Award.

B. Attendance Required:
   1. Owner.
   2. Architect.
   3. Contractor.
   4. Owner's Commissioning Agent.
   5. Major subcontractors, consultants, and others as necessary and appropriate.

C. Agenda:
   1. Execution of Owner-Contractor Agreement.
   2. Submission of executed bonds and insurance certificates.
   3. Distribution of Contract Documents.
   4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
   5. Designation of personnel representing the parties to Contract and Architect.
   6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
   7. Scheduling.
   8. Site mobilization and utilization.
   9. Other project-specific items on pre-distributed agenda.

D. Architect shall record minutes and distribute digital copies to Owner, Contractor, and other attendees. Contractor shall be responsible for distribution to subcontractors and other personnel affected by decisions made.

3.03 INDOOR AIR QUALITY (IAQ) MANAGEMENT PLAN DEVELOPMENT SESSION

A. Architect will schedule a meeting after Notice of Award.

B. Attendance Required:
   1. Owner.
   2. Owner's Commissioning Agent.
   3. Architect.
   4. Mechanical engineer.
   5. Contractor.

6. HVAC subcontractor.
7. Other major subcontractors, consultants, and others as necessary and appropriate.

C. Agenda:
1. Protection of Materials: Discussion of how and where materials that could impact IAQ will be stored, including but not limited to, the following:
   a. Insulation.
   b. Gypsum board.
   c. Flooring materials.
   d. Ceiling panels.
   e. Furnishings.
   f. Odorous chemicals.
2. Protection of HVAC: Discussion of how HVAC equipment will be stored installed, and operated during construction.
3. Pathway Interruption: Discussion of how airflow between construction zones will be limited to prevent the spreading of pollutants from one part of the building to another.
4. Housekeeping: Discussion of how the building will be kept clean and dry.
5. Materials Installation Scheduling: Discussion of what wet (odor emitting) materials will be used on the project, in order to schedule their installation before fuzzy (odor absorbing) materials.

3.04 PREINSTALLATION MEETINGS

A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section. Do not allow installation of affected work to proceed until preinstallation meeting can be held.
1. Include all preinstallation meetings on the Project Schedule.

B. Require attendance of parties directly affecting, or affected by, work of the specific section.

C. Notify Architect and Owner 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 copies to Architect, Owner, participants, and those affected by decisions made.

3.05 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. Owner.
2. Architect.
3. Contractor's superintendent.
4. Other subcontractors or consultants as required for the specific parts of the Work to be discussed.

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. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Maintenance of quality and work standards.
11. Effect of proposed changes on progress schedule and coordination.
12. Other business relating to the work.

E. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.

3.06 CLOSEOUT MEETING

A. Schedule and administer closeout meeting no later than 90 days before the scheduled Date of Substantial Completion.

B. Make arrangements for the meeting, prepare agenda with copies for participants, and preside at the meeting.

C. Attendance Required:
1. Owner.
2. Architect.
3. Contractor's superintendent.
4. Major subcontractors.
5. Other subcontractors or consultants as required.

D. Agenda:
1. Review closeout requirements and procedures in Division 1 Section "Execution and Closeout Requirements."
2. Review startup, testing, and adjusting of all systems, including testing/adjusting/balancing (TAB) and Commissioning.
3. Coordination of inspections by local authorities having jurisdiction and third party Special Inspectors as required to obtain Certificate of Occupancy.
4. Coordination of Owner's occupancy and changeover of utilities, insurance, and building keying/lock system.
5. Procedures for Contractor's Correction Punch List, Architect's Substantial Completion inspection, and Final Correction Punch List.
6. Delivery, turnover, and storage of maintenance materials, attic stock, special tools, and other non-installed materials.
7. Coordination of closeout documentation, including demonstration and training materials and videos, as built/record documents, operation and maintenance binders, and warranty binders.
8. Removal of temporary facilities, construction equipment, and tools.
9. Final cleaning, touchup, restoration, and preventive maintenance.
10. Coordination of final Applications for Payment.

E. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.

3.07 DAILY CONSTRUCTION REPORTS

A. Include only factual information. Do not include personal remarks or opinions regarding operations and/or personnel.

B. Prepare a daily construction report recording the following information concerning events at Project site and project progress:
   1. Date.
   2. High and low temperatures, and general weather conditions.
   3. List of subcontractors at Project site.
   4. Approximate count of personnel at Project site.
   5. Major equipment at Project site.
   6. Material deliveries.
   7. Safety, environmental, or industrial relations incidents.
   8. Meetings and significant decisions.
   9. Unusual events (submit a separate special report).
   10. Stoppages, delays, shortages, and losses. Include comparison between scheduled work activities (in Contractor's most recently updated and published schedule) and actual activities. Explain differences, if any. Note days or periods when no work was in progress and explain the reasons why.
   11. Directives and requests of Authority(s) Having Jurisdiction (AHJ).
   12. Testing and/or inspections performed.
   13. Signature of Contractor's authorized representative.

3.08 COORDINATION DRAWINGS AND COORDINATION CONFERENCE

A. Coordination Drawings: The Contractor shall prepare coordination drawings of all spaces where utilities, systems, and other components converge or intersect and efficient installation is required to accommodate all components.
   1. Prepare coordination drawings of the following spaces, at minimum. Supplement with additional spaces as required by project-specific conditions.
      a. Above ceilings.
      b. Vertical chases, shafts, and wall cavities.
      c. Mechanical and electrical rooms, fire pump room, and other major utility spaces.
   2. Provide accurate overall dimensions of components (for example, outside diameters of pipe and conduit, or overall ductwork dimensions including insulation and enclosure thickness).
   3. Include accessory components of systems that could cause potential conflicts, such as bracing, slotted channel framing, hangers, and other supports, valve handles, flanges, fittings, cable/wire management trays, and other similar components.
   4. Include sequence of installation of all components, materials, and systems.
   5. Include means of access to each component, material, or system, for maintenance and repairs.
   6. Provide additional coordination drawings as required by individual specification sections.
   7. Prepare Coordination Drawings using project-specific information. Do not use photocopies or reproductions of Contract Documents, and do not use standard details or data from manufacturers, suppliers, or other outside parties.

8. Drawing Files: The Contractor may develop coordination drawings using 2D CAD software or with 3D BIM software with clash-detection functionality.
    a. The Architect will furnish original 3D BIM model or 2D DWG files for Contractor's use upon receipt of Architect's "Request Form for Electronic Files". A copy of this form shall be provided to the Contractor upon request.
        1) The Architect makes no guarantee to the accuracy of components in electronic files. The Contractor shall coordinate electronic data with the Contract Documents in order to provide final Coordination Drawings.
        2) If using 2D files, the Contractor shall prepare drawings in multiple views (for example, RCP and section) to fully represent 3D space, for example plenum heights, wall assembly thicknesses, etc.
9. Submittal: Submit Coordination Drawings as a "Submittal for Information." Architect will not approve Coordination Drawings, but will keep on file for use in subsequent coordination and conflict resolution.

B. Coordination Conference: Schedule and conduct a Coordination Conference prior to beginning construction or rough-in of affected work. Require attendance by all affected trades and installers.
1. Identify the Coordination Conference as a "milestone" date on the Construction Progress Schedule.
2. Advise the Architect of all potential conflicts identified in the Coordination Drawings and at the Coordination Conference.
3. Do not proceed with construction or installation of components, materials, or systems until potential conflicts have been resolved and affected parties have agreed to a remedy.
4. Remedies to address conflicts not identified in the Coordination Drawings, at the Coordination Conference, or otherwise addressed prior to construction or installation of affected components, materials, and systems, or discovery of a non-workable situation not identified or addressed, will not be considered as a basis for delay, time extension, or additional cost to the Contract.

3.09 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. 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 electronic file. PDF format is preferred.

C. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is 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 - 016000 - 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.
   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.
      a. The Owner reserves the right to assess the Contractor for the costs (on time-and-materials basis) incurred by the Architect, and any of its consultants, due to processing of such RFIs.

D. 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.
   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.

E. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.

F. 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.

G. 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.

H. 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. When the Architect provides a response to an RFI, that RFI shall be closed. If there is additional information required, or a question about the response itself, then another RFI with a new number shall be generated by the Contractor. At no time shall an RFI be "re-opened" or remain open after the Architect has formally responded.
   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.

3.10 SUBMITTAL SCHEDULE

A. Submit to Architect for review a schedule for submittals in tabular format.
   1. Coordinate with Contractor's construction schedule and schedule of values.
   2. Format schedule to allow tracking of status of submittals throughout duration of construction.
   3. 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.
   4. 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.
      b. Account for a reasonable duration of time to allow for final color selections, approvals, and preparation of final finish schedules (one finish schedule for interior color selections, and one for exterior color selections). This period shall begin upon receipt of all submittals requiring color selection.

3.11 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:
   1. Product data.
   2. Design data.
   3. Shop drawings.
   4. Samples for selection.
   5. Samples for verification.

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. Samples will be reviewed for aesthetic, color, or finish selection.

D. Color Selection: In individual specification sections, specific items are identified which require color/finish selections to be made by the Architect from color chart or sample submittals. The Submittal Schedule, prepared according to “Submittal Schedule” paragraph above, shall identify these required color/finish submittals.
   1. Submittals requiring color selection must be submitted by Contractor and approved by Architect for conformance with Contract Documents prior to the start of the color selection process. When the submittals have been approved for conformance with Contract Documents, the process for color selection, presentation of color concepts, Owner approval, and Color Schedule preparation will begin.
   2. Interior Color Selections: The Architect will make coordinated selections of colors/finishes for the building interior, present the resulting color concepts to the Owner for approval, and prepare the actual Interior Color Schedule for the Work.
   3. Exterior Color Selections: The Architect will make coordinated selections of colors/finishes for the building exterior and prepare Exterior Color Schedule.

E. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below.

3.12 SUBMITTALS FOR INFORMATION

A. When the following are specified in individual sections, submit them for information:
   1. Certificates.
   2. Test reports.
   3. Inspection reports.
   4. Manufacturer's instructions.
   5. Manufacturer's field reports.
   6. Other types indicated.

B. Submit for Architect's knowledge as contract administrator or for Owner.

3.13 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 017800 - Closeout Submittals:
   1. Project record documents.
   2. Operation and maintenance data.
   3. Warranties.
   4. Bonds.
   5. Other types as indicated.

3.14 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. Selection Samples: Submit one set of manufacturer's charts indicating full range of available colors, textures, patterns, and other aesthetic qualities.

C. Verification Samples: Submit three sets of physical samples. Two sets will be retained by Architect, the third will be returned to the Contractor. Maintain approved sample at the Project site for use in comparing to installed Work.

1. Where a full-size assembly of multiple components is required as a sample (for example, railing section or full-size cabinet), only one sample is required for those items.

3.15 SUBMITTAL PROCEDURES

A. General Requirements:

1. Use a single transmittal for all submittals required by each individual specification section, unless otherwise indicated.
    a. Verification samples and large shop drawing submittals may be submitted under separate cover when approved by Architect.
2. Transmit using AIA G810 or other approved form.
3. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
4. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
5. 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.
6. 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. Upload submittals in electronic form to Electronic Document Submittal Service website.
7. Schedule submittals to expedite the Project, and coordinate submission of related items.
    a. Allow sufficient time for administrative processing, Architect's initial review, and potential resubmittals.
        1) Large submittals may require longer review durations. Large or multi-part submittals (such as structural steel or aluminum storefront and curtainwall) may be submitted by building area, building level, or otherwise subdivided "packages" with the approval of the Architect. Subdivided "packages" will be reviewed one at a time in the order received. If large submittals are submitted in their entirety as a single package, the Architect may elect to review and return portions of the submittal individually, and will coordinate the schedule for return of these partial reviews with the Contractor for sequencing in the Work.
    b. Allow additional time for submittals requiring sequential reviews involving Architect's consultants, Owner, or another affected party.
    c. No extensions to the project schedule shall be granted due to delays that can be attributed to submittal processing or failure to allow for sequential reviews or resubmittals.
8. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
9. When revised for resubmission, identify all changes made since previous submission.
10. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
11. Incomplete submittals may not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
12. 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.

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.
   3. Selection Samples: Provide color charts that accurately relay color, pattern, and texture information. Photographs or photocopies of color charts are unacceptable and subject to rejection.
   4. Verification Samples: Provide physical samples of each color selected by Architect from Selection Samples. Verification samples shall be manufactured and prepared identically to the material that shall be used in the installed Work. Label each sample clearly with manufacturer, product name, and color, texture, and/or pattern name as applicable. Photographs of physical samples are unacceptable and subject to rejection.

3.16 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, but will take no other action.

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 actions on items submitted for review:
   1. Authorizing purchasing, fabrication, delivery, and installation:
      a. "Approved as Noted":
         1) Where review notations indicate revisions are necessary, submit corrected item, with review notations acknowledged and incorporated.
   2. Not Authorizing fabrication, delivery, and installation:
      a. "Revise and Resubmit":
         1) Resubmit revised item, with review notations acknowledged and incorporated.
      b. "Rejected/Resubmit":
         1) New submittal required, with item complying with requirements of Contract Documents.
      c. "Color Selection Required":

1) Color selections for the entire project, or portion thereof, will be provided after receipt of all color charts and samples required for the Project.

d. "Not Submitted":

1) Additional submittal items are required that were not provided in the original submittal.

E. Architect's actions on items submitted for information:

1. Items for which no action was taken:

a. "Not Reviewed": To notify the Contractor that the submittal has been received for record only.

END OF SECTION 013000

SECTION 013216
CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.01 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. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.

1. Include written certification that major contractors have reviewed and accepted proposed schedule.

D. Within 10 days after joint review, submit complete schedule.

E. Submit updated schedule with each Application for Payment.

F. Submit in PDF format.

1.02 QUALITY ASSURANCE

A. Scheduler: Contractor's personnel or specialist Consultant specializing in CPM scheduling with experience in scheduling construction work of a complexity comparable to this Project, and having use of computer facilities capable of delivering a detailed graphic printout within 48 hours of request.

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.

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 work of separate phases and other logically grouped activities.

C. Identify all major milestone dates, including, but not limited to, Notice to Proceed and Substantial and Final Completion dates.

D. Identify duration of each activity, in maximum 15 day intervals.

E. Incorporate work restrictions indicated in Section 011000 - Summary, if any.

F. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.

G. Provide separate schedule of submittal dates for shop drawings, product data, and samples, owner-furnished products, products identified under Allowances, and dates reviewed submittals will be required from Architect. Indicate decision dates for selection of finishes.

H. Indicate procurement duration and delivery dates for long-lead time items.

I. Coordinate submittal approval process with procurement and delivery requirements. Submittals requiring resubmission or revision for approval will not be allowed as a basis for schedule impacts.

J. Indicate delivery dates for owner-furnished products and products identified under Allowances.

K. Indicate the time period for color selection activity and approval by Owner and Architect, as required per Section 013000 - Administrative Requirements.

L. Indicate date of changeover from temporary to permanent utilities.

M. Indicate time periods for Commissioning activities, equipment startup, and testing and balancing.

N. Provide a reasonable time period prior to the date of Substantial Completion for administrative activities and procedures.

O. 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 critical path activities.

C. Identify the first work day of each week.

3.04 NETWORK ANALYSIS (CPM)

A. Prepare network analysis diagrams and supporting mathematical analyses using the Critical Path Method.

B. 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.

C. Mathematical Analysis: Tabulate each activity of detailed network diagrams, using calendar dates, and identify for each activity:
   1. Preceding and following event numbers.
   2. Activity description.
   3. Estimated duration of activity, in maximum 15 day intervals.
   4. Earliest start date.
   5. Earliest finish date.
   6. Actual start date.
   7. Actual finish date.
   8. Latest start date.
   9. Latest finish date.
   10. Total and free float; float time shall accrue to Owner and to Owner's benefit.
   11. Percentage of activity completed.
   12. Responsibility.

D. Analysis Program: Capable of accepting revised completion dates, and recomputation of all dates and float.

E. Required Reports: List activities in sorts or groups:
   1. By preceding work item or event number from lowest to highest.
   2. By amount of float, then in order of early start.
   3. In order of latest allowable finish dates.
   4. Listing of activities on the critical path.

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. Schedule revisions shall not modify any Contract Dates or the Contract Sum, unless specifically approved and documented via Change Order.

G. Submit reports required to support recommended changes.

H. Provide narrative report to define problem areas, anticipated delays, and impact on the schedule. Report corrective action taken or proposed and its effect.

I. Recovery Schedule: If the Contractor is 14 or more days behind schedule, in the opinion of the Owner, the Contractor shall prepare a Recovery Schedule, incorporating a reasonable, mutually agreed upon length of time to return the Work to the approved Schedule. The Recovery Schedule shall be prepared to the same level of detail as the original construction progress schedule. Submit the recovery schedule for Owner review; do not proceed until the Owner has approved.
   1. At the end of the recovery period, Owner shall reevaluate construction progress and determine if the Recovery Schedule has been successfully completed. If completed, Owner shall direct the Contractor to proceed with the latest approved Construction Schedule.
      a. If the Contractor is still behind schedule at the end of the recovery period, the Owner shall direct the Contractor to provide additional schedule revisions to complete the recovery, or may at its option pursue other means of resolution as provided for by the Contract Documents.
   2. Need for and preparation of a Recovery Plan shall not be the basis of additional cost to the Owner or extension of Project Schedule, unless the Contractor can demonstrate that the reason for being behind schedule is no fault of their own.

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.

END OF SECTION 013216

SECTION 014000
QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 DEFINITIONS

A. Contractor's Quality Control Plan: Contractor's management plan for executing the Contract for Construction.

B. Contractor's Professional Design Services/Delegated Design: Design of some aspect or portion of the project by party other than the design professional of record. Provide these services as part of the Contract for Construction.

1. Design Services Types Required:

a. Construction-Related: Services Contractor needs to provide in order to carry out the Contractor’s sole responsibilities for construction means, methods, techniques, sequences, and procedures.

b. Design-Related: Design services explicitly required to be performed by another design professional due to highly-technical and/or specialized nature of a portion of the project. Services primarily involve engineering analysis, calculations, and design, and are not intended to alter the aesthetic aspects of the design.

C. Design Data: Design-related, signed and sealed drawings, calculations, specifications, certifications, shop drawings and other submittals provided by Contractor, and prepared directly by, or under direct supervision of, appropriately licensed design professional.

1.02 CONTRACTOR'S CONSTRUCTION-RELATED PROFESSIONAL DESIGN SERVICES

A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.

B. Provide such engineering design services as may be necessary to plan and safely conduct certain construction operations, pertaining to, but not limited to the following:

1. Temporary sheeting, shoring, or supports.
2. Temporary scaffolding.
3. Temporary bracing.
4. Temporary falsework for support of spanning or arched structures.
5. Temporary foundation underpinning.
6. Temporary stairs or steps required for construction access only.
7. Temporary hoist(s) and rigging.
8. Investigation of soil conditions and design of temporary foundations to support construction equipment.
9. Additional temporary controls as required.

1.03 CONTRACTOR'S DESIGN-RELATED PROFESSIONAL DESIGN SERVICES

A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.

B. Base design on performance and/or design criteria indicated in individual specification sections.

1. Submit a Request for Information to Architect if the criteria indicated are not sufficient to perform required design services.

C. Scope of Design Services/Delegated Design: As required by individual specification sections.

D. Scope of Contractor's Professional Design Services: Provide for the following items of work:
   1. Sprinkler Layout: Coordinate with ceiling installation, detailed pipe layout, and hydraulic calculations as described in Section 211300 - Fire-Suppression Sprinkler Systems.

1.04 SUBMITTALS

A. Designer's Qualification Statement: Submit for Architect's knowledge as contract administrator, or for Owner's information.
   1. Include information for each individual professional responsible for producing, or supervising production of, design-related professional services provided by Contractor.
      a. Full name.
      b. Professional licensure information.
      c. Statement addressing extent and depth of experience specifically relevant to design of items assigned to Contractor.

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, require testing agency to promptly distribute digital copy of report to Architect, Owner, Contractor, and others as required.
   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.

D. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor 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:
   1. Submit report promptly to Architect for information.
   2. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications:
   1. Prior to start of work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
   2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
   3. Qualification Statement: Provide documentation showing testing laboratory is accredited under OSHA's Nationally Recognized Testing Laboratory (NRTL) program or through the National Institute of Standards and Technology's (NIST's) National Voluntary Laboratory Accreditation Program (NVLAP).

B. Designer Qualifications: Where professional engineering design services and design data submittals are specifically required of Contractor by Contract Documents, provide services of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

C. Contractor's Quality Control (CQC) Plan:
   1. Prior to start of work, submit a comprehensive plan describing how contract deliverables will be produced. Tailor CQC plan to specific requirements of the project. Include the following information:
      a. Management Structure: Identify personnel responsible for quality. Include a chart showing lines of authority.
         1) Include qualifications (in resume form), duties, responsibilities of each person assigned to CQC function.
      b. Management Approach: Define, describe, and include in the plan specific methodologies used in executing the work.
         1) Management and control of documents and records relating to quality.
         2) Communications.
         3) Coordination procedures.
         4) Resource management.
         5) Process control.
         6) Inspection and testing procedures and scheduling, including inspections by authorities having jurisdiction and special inspections.
         7) Control of noncomplying work.
         8) Tracking deficiencies from identification, through acceptable corrective action, and verification.
         9) Control of testing and measuring equipment.
         10) Project materials certification.
         11) Managerial continuity and flexibility.
      c. Acceptance of the plan is required prior to start of construction activities not including mobilization work. Owner's acceptance of the plan will be conditional and predicated on continuing satisfactory adherence to the plan. Owner reserves the right to require

Contractor to make changes to the plan and operations, including removal of personnel, as necessary, to obtain specified quality of work results.

1.06 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, comply with the higher quality or quantity, and provide documentation of the conflict to the Architect.

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.

1.07 TESTING AND INSPECTION AGENCIES AND SERVICES

A. Owner will employ and pay for services of an independent testing agency to perform Special Inspections and other specified testing indicated in individual specification sections.

B. Where indicated in individual specification sections, Contractor shall employ and pay for services of an independent testing agency to perform other specified testing.

C. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

D. Contractor Employed Agency: Testing agency shall comply with requirements of ASTM E 329, and shall be certified through OSHA's Nationally Recognized Testing Laboratory (NRTL) program or through the National Institute of Standards and Technology's (NIST's) National Voluntary Laboratory Accreditation Program (NVLAP).

1. Testing Equipment: Calibrated at reasonable intervals either by NIST or using an NIST established Measurement Assurance Program, under a laboratory measurement quality assurance program.

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. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.

D. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

E. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.
   1. Architect will issue written comments within seven (7) working days of initial review and each subsequent follow up review of each mock-up.
   2. Make corrections as necessary until Architect's approval is issued.

F. Architect will use accepted mock-ups as a comparison standard for the remaining Work.

G. 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.

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 for testing and inspection required.

B. Testing Agency Duties for Contractor-Employed Testing and Inspection Agencies:
   1. Test samples of mixes submitted by Contractor.
   2. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
   3. Perform specified sampling and testing of products in accordance with specified standards.
   4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   5. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
   6. Perform additional tests and inspections required by Architect.
   7. Attend preconstruction meetings and progress meetings.

8. Submit reports of all tests/inspections specified.

C. 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.

D. 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.
   7. Coordinate repairs where testing and inspection has damaged the Work.

E. Re-testing and/or re-inspections required because of non-compliance with specified requirements shall be performed by the same agency. Do not proceed with construction activities that would conceal or cover work needing re-testing or re-inspection.

F. Re-testing and/or re-inspections required because of non-compliance with specified requirements shall be paid for by Contractor.

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, and field quality control requirements as applicable, and to initiate instructions when necessary.

B. Provide a written report of observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions or Contract Documents. Obtain Owner's approval prior to proceeding with any modifications.

3.06 DEFECT ASSESSMENT

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

B. Contractor may request to restore defective Work or portions of the Work to comply with specified requirements in lieu of replacement. Obtain Owner's approval prior to proceeding with restoration.

C. If, in the opinion of Owner, it is not practical to restore or remove and replace the work, Owner will direct an appropriate remedy or adjust payment.

END OF SECTION 014000

SECTION 014200
DEFINITIONS AND REFERENCE STANDARDS

PART 1 GENERAL

1.01 SUMMARY

A. The definitions include in this section supplement, but do not replace, the definitions contained in the General Conditions. In the event of duplication, the General Conditions shall govern.

B. Other definitions are included in individual specification sections.

1.02 DEFINITIONS

A. Furnish: To supply, deliver, unload, and inspect for damage.

B. Install: To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use.

C. Product: Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.

D. Provide: To furnish and install.

E. Supply: Same as Furnish.

F. Installer: A Contractor or other entity engaged by Contractor, as an employee, subcontractor, or contractor of lower tier, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that specified requirements apply exclusively to tradespeople of the corresponding generic name.

G. Experienced: When used with the term "Installer," this term means having successfully completed previous work similar in size and scope to this Project; being familiar with the special requirements indicated; and having complied with the requirements of local authorities having jurisdiction.

H. Replace: Provide an acceptable like product or material in place of a missing or unacceptable (rejected) product or material. To "replace" an unacceptable product or material includes its removal and disposal.

I. Punch List: A written list of unfinished Work and defective Work resulting from inspection and testing to determine whether Substantial Completion has been accomplished. The unfinished Work and defective Work must be finished and corrected to obtain Substantial or Final Completion, in accordance with the General Conditions.

J. Written or Printed: When used in conjunction with manufacturer's product data or installation requirements, either of these terms may be used to require compliance with manufacturer's current printed and published information.

1.03 REFERENCE STANDARDS

A. For products or 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 or local authorities having jurisdiction.

B. Should specified reference standards conflict with Contract Documents, request clarification from the Architect before proceeding.

C. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of the Architect shall be altered by Contract Documents by mention or inference otherwise in any reference document.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 014200

SECTION 014520 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

    a. Constant-volume air systems.

2. Balancing Hydronic Piping Systems:

    a. Constant-flow hydronic systems.

3. Testing, Adjusting, and Balancing Equipment:
    a. Motors.
    b. Heat-transfer coils.

4. Testing, adjusting, and balancing existing systems and equipment.Tests described below in "Additional Tests" are considered beyond the standard test and balance scope and should only be included if the design professional believes the additional time and expense are warranted.

5. Additional Tests.
    a. Seasonal tests.
    b. Controls verification.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. BAS: Building automation system.

C. NEBB: National Environmental Balancing Bureau.

D. TAB: Testing, adjusting, and balancing.

E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

1.4 PREINSTALLATION MEETINGS

A. TAB Conference: If requested by the Owner or Architect, conduct a TAB conference at [**Project site**] <**Insert location**> after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of [**14**] <**Insert number**> days' notice of scheduled meeting time and location.

1. Minimum Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Needs for coordination and cooperation of trades and subcontractors.
d. Proposed procedures for documentation and communication flow.

1.5 ACTION SUBMITTALS

A. Sustainable Design Submittals:
1. TAB Report: Documentation indicating that Work complies with ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB agent and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 60 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 90 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. System Readiness Checklists: Within 90 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports: Within 14 days of completion of balancing work, submit testing and balancing report.

G. Sample report forms.

1.7 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by AABC or NEBB. TAB provider shall be an independent company from the contractors performing the work.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC or NEBB.
2. TAB Technician: Employee of the TAB specialist and certified by AABC or NEBB as a TAB technician.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

D. The following information shall be submitted as part of the Quality Assurance Submittal:

1. Provide evidence of satisfactory completion of at least two projects of similar size and scope. Submit the following for each project:

    a. Completed testing and balancing reports for each project.
    b. If not included in the testing and balancing report, provide equipment startup checklists for each project.
    c. Owner contact for each project.
    d. Design engineer contact for each project.
    e. Architect contact for each project.

2. The Architect shall determine whether the agent is qualified and the decision shall be final. Re-submittals on behalf of the same company shall not be considered.

E. TAB Conference: After approval of the TAB submittals, the TAB specialist shall arrange a meeting with the Owner's and the Architect's representatives to develop a mutual understanding of the details and review the TAB strategies and procedures plan. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installer, and other support personnel. Provide 14 days' notice of scheduled meeting time and location.

1. Minimum Agenda:

    a. Submittal distribution requirements.
    b. Contract documents examination report.
    c. TAB strategies and procedures plan.
    d. Work schedule and project site access requirements.
    e. Coordination and cooperation of trades and subcontractors.
    f. Coordination of documentation and communication flow.
    g. Systems readiness checklists.

F. TAB Reports: Use standard forms from AABC's "National Standards for TAB" or NEBB's "Procedural Standards for TAB of Environmental Systems."

G. Instrumentation Type, Quantity, and Accuracy: As described in the "AABC National Standards for Total System Balance" or NEBB's "Procedural Standards for TAB of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

H. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

1.8 FIELD CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.9 COORDINATION

A. Coordinate the efforts of work performed under other sections for operation of systems and equipment to support and assist TAB activities.

B. Notice: Provide 7 days' notice to the Contractor and Architect for each test. Include scheduled test dates and times.

C. Perform TAB after any required leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.10 WARRANTY

A. General Warranty: The national project performance guarantee indicated in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Guarantee: Provide a guarantee on NEBB or AABC forms stating that NEBB or AABC will assist in completing the requirements of the Contract Documents if the TAB Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:

1. The certified Agent has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine 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.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.

L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes 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. Perform system-readiness checks of HVAC systems and equipment 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.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance," ASHRAE 111, or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. 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 exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

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

L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

    a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:

    a. Measure static pressure directly at the fan outlet or through the flexible connection.
    b. Measure static pressure directly at the fan inlet or through the flexible connection.
    c. Measure static pressure across each component that makes up the air-handling system.
    d. Report artificial loading of filters at the time static pressures are measured.

3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
4. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.6 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. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:

1. Check liquid level in expansion tank.
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.

3.7 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Adjust pumps to deliver total design gpm.

1. Measure total water flow.

a. Position valves for full flow through coils.
b. Measure flow by main flow meter, if installed.
c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

2. Measure pump TDH as follows:

a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
c. Convert pressure to head and correct for differences in gage heights.
d. 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.
e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

B. Adjust flow-measuring devices installed in mains and branches to design water flows.

1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

C. Adjust flow-measuring devices installed at terminals for each space to design water flows.

1. Measure flow at terminals.
2. Adjust each terminal to design flow.
3. Re-measure each terminal after it is adjusted.
4. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
5. Perform temperature tests after flows have been balanced.

D. For systems with pressure-independent valves at terminals:

1. Measure differential pressure and verify that it is within manufacturer's specified range.
2. Perform temperature tests after flows have been verified.

E. For systems without pressure-independent valves or flow-measuring devices at terminals:

1. Measure and balance coils by either coil pressure drop or temperature method.
2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

F. Verify final system conditions as follows:

1. Re-measure and confirm that total water flow is within design.

2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
3. Mark final settings.

G. Verify that memory stops have been set.

3.8 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.9 CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify temperature control system is operating within the design limitations.
2. Confirm that the sequences of operation comply with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.10 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: 0 to plus 10 percent.
2. Air Outlets: Plus or minus 10 percent.
3. Return Inlets: Plus or minus 10 percent.

4. Exhaust Inlets: 0 to plus 10 percent.
5. Heating-Water Flow Rate: Plus or minus 10 percent.
6. Cooling-Water Flow Rate: Plus or minus 10 percent.
7. Unless indicated otherwise: Plus or minus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.11 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.12 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
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.
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. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

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

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.

i. Center-to-center dimensions of sheave and amount of adjustments in inches.
j. Number, make, and size of belts.
k. Number, type, and size of filters.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Preheat-coil static-pressure differential in inches wg.
g. Cooling-coil static-pressure differential in inches wg.
h. Heating-coil static-pressure differential in inches wg.
i. Outdoor airflow in cfm.
j. Return airflow in cfm.
k. Outdoor-air damper position.
l. Return-air damper position.
m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch.
f. Make and model number.
g. Face area in square feet.
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outdoor-air, wet- and dry-bulb temperatures in deg F.

e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Water flow rate in gpm.
i. Water pressure differential in feet of head or psig.
j. Entering-water temperature in deg F.
k. Leaving-water temperature in deg F.
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig.
n. Refrigerant suction temperature in deg F.
o. Inlet steam pressure in psig.

G. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Fuel type in input data.
g. Output capacity in Btu/h.
h. Ignition type.
i. Burner-control types.
j. Motor horsepower and rpm.
k. Motor volts, phase, and hertz.
l. Motor full-load amperage and service factor.
m. Sheave make, size in inches, and bore.
n. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Entering-air temperature in deg F.
c. Leaving-air temperature in deg F.
d. Air temperature differential in deg F.
e. Entering-air static pressure in inches wg.
f. Leaving-air static pressure in inches wg.
g. Air static-pressure differential in inches wg.
h. Low-fire fuel input in Btu/h.
i. High-fire fuel input in Btu/h.
j. Manifold pressure in psig.
k. High-temperature-limit setting in deg F.
l. Operating set point in Btu/h.
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in Btu/h.

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

    a. System identification.
    b. Location.
    c. Make and type.
    d. Model number and size.
    e. Manufacturer's serial number.
    f. Arrangement and class.
    g. Sheave make, size in inches, and bore.
    h. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Motor Data:

    a. Motor make, and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches, and bore.
    f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
    g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

    a. Total airflow rate in cfm.
    b. Total system static pressure in inches wg.
    c. Fan rpm.
    d. Discharge static pressure in inches wg.
    e. Suction static pressure in inches wg.

I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

    a. System and air-handling-unit number.
    b. Location and zone.
    c. Traverse air temperature in deg F.
    d. Duct static pressure in inches wg.
    e. Duct size in inches.
    f. Duct area in square feet.
    g. Indicated airflow rate in cfm.
    h. Indicated velocity in fpm.
    i. Actual airflow rate in cfm.
    j. Actual average velocity in fpm.
    k. Barometric pressure in psig.

J. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

    a. System and air-handling-unit identification.
    b. Location and zone.
    c. Room or riser served.
    d. Coil make and size.
    e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

    a. Airflow rate in cfm.
    b. Entering-water temperature in deg F.
    c. Leaving-water temperature in deg F.
    d. Water pressure drop in feet of head or psig.
    e. Entering-air temperature in deg F.
    f. Leaving-air temperature in deg F.Net positive suction head is important for pumps in open circuits and for pumps handling fluids at elevated temperatures.

K. Instrument Calibration Reports:

1. Report Data:

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

3.13 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of [**Architect**] [**Owner**] [**Construction Manager**] [**commissioning authority**].

B. [**Architect**] [**Owner**] [**Construction Manager**] [**Commissioning authority**] shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

E. If TAB work fails, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
3. If the second verification also fails, [**Owner**] [**design professional**] [**Architect**] may contact AABC Headquarters regarding the AABC National Performance Guaranty.

F. Prepare test and inspection reports.

3.14 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

C. When requested, provide up to 32 hours by the technician that provided services under this Section to support commissioning.

END OF SECTION 014520

SECTION 015000
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 DEWATERING

A. Provide temporary means and methods for dewatering all temporary facilities and controls, in compliance with local authority having jurisdiction.

B. Maintain temporary facilities in operable condition.

1.02 TEMPORARY UTILITIES

A. Owner will provide the following, without metering:
   1. Electrical power, consisting of connection to existing facilities.
   2. Water supply, consisting of connection to existing facilities.

B. Temporary Lighting: Provide temporary lighting of type and producing lighting levels necessary for proper installation of the Work.

C. Temporary Heating, Cooling, and Ventilation: Provide temporary measures and equipment as required for curing, drying, and humidity control. Comply with manufacturer's installation instructions for specific product requirements.
   1. Provide measures and equipment to meet warranty requirements of interior woodwork specified in Division 6 and/or Division 12 sections.
   2. Use of Permanent HVAC Facilities and Equipment: Use of HVAC equipment shall be subject to Owner approval.
      a. Protect new and existing HVAC equipment from intrusion of dust, silica, dirt and debris during construction operations.
      b. Cover all openings in new and existing inactive ductwork during construction operation with minimum 6 mil polyethylene sheet.
      c. Where use of existing HVAC equipment is approved by Owner, provide temporary filters with a minimum MERV of 8. Change the filters every two weeks while construction is ongoing. Provide new filters at Substantial Completion; do not change out temporary filter until approved by Architect.
      d. Do not perform testing and balancing of HVAC equipment until dust, silica, dirt and debris producing activities are complete.

1.03 TELECOMMUNICATIONS SERVICES

A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.

B. Telecommunications services shall include:
   1. Telephone Service: Contractor shall ensure that all of its forces, including on-site managers/supervisors of each Subcontractor, have mobile devices and adequate voice and data coverage for on-site operations.
   2. Internet Connections: Contractor shall ensure that all of its forces have access to high speed internet connection with wireless capability; wireless network shall support Internet speed tests in excess of 5 Mbps symmetrical (up/down).
   3. Video Conferencing and Video Site Visit/Walkthrough Infrastructure: Maintain personal computer/laptop with large format display screen and video conferencing software in the common-use field office.

a. Maintain equipment in common-use field office for site visits and walkthroughs, including a portable, high quality digital video camera, audio headset with microphone for walkthrough commentary/narration, and accessories including connection cables and battery packs.

1.04 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
   1. Provide temporary unisex toilet units and all required disposable supplies.
   2. Provide handwash stations and hand sanitizer at each toilet unit.
   3. Provide regular servicing of portable facilities by professional servicing company; including draining, cleaning, and disinfecting.

B. New permanent facilities may not be used during construction operations.

C. Maintain daily in clean and sanitary condition.

1.05 BARRIERS

A. 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 from construction operations and demolition.

B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building, and for emergency egress.

C. Provide protection for plants designated to remain. Replace damaged plants.

D. Protect vehicular traffic, stored materials, site, and structures from damage.

1.06 FENCING

A. Barrier Mesh Fence: Provide minimum 6-foot height open-mesh polypropylene barrier fabric mounted on lumber or galvanized steel posts to isolate and define construction area and prevent accidental public access.

B. Construction: Commercial grade chain link fence.
   1. Contractor may provide either fixed or portable fencing to suit conditions. For portable fencing, provide concrete or galvanized steel bases for supporting posts. Bases for portable fencing shall not obstruct sidewalks or other pathways used by pedestrians.

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

D. Unless otherwise indicated, provide barrier mesh fencing to enclose the approximate extent of the entire construction site. Chain link fencing shall be used to enclose Contractor's field office and laydown/storage areas, areas of the site actively in construction, and as deemed necessary by Contractor.

1.07 EXTERIOR ENCLOSURES

A. Provide temporary 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.

1.08 INTERIOR ENCLOSURES

A. Provide temporary partitions to separate work areas from Owner-occupied areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.

B. Construction: Framing and gypsum board sheet materials with closed joints and sealed edges at intersections with existing surfaces:

1.09 SECURITY

A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

1. Contractor shall repair damage to existing facilities caused by Construction operations.

B. Coordinate with Owner's security program.

C. Environmental Protection: Comply with EPA, OSHA and other regulatory requirements to prevent contamination of site, air, and public sewer/runoff.

1. Provide additional work restrictions and protective measures as indicated on Civil/Site Drawings and as specified in Section 011000 - Summary.

1.10 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. Designated existing on-site roads may be used for construction traffic.

F. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

G. Provide watering trucks, mulch, chemical stabilizers, or other control measures, complying with environmental protection requirements, to prevent airborne dust and silica from becoming a nuisance or health issue to Contractor personnel, neighboring properties, and the public.

1.11 WASTE REMOVAL

A. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.

B. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.

C. Provide containers with lids. Remove trash from site periodically.

D. 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.

E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.12 PROJECT IDENTIFICATION

A. Project signs are not part of the Contract.

1. The Contractor may, at their option and expense, elect to provide Project identification signs. Proposed signs shall comply with layout and details indicated on Drawings, and shall be submitted for Owner approval. Unauthorized signs are not permitted.

B. Provide project identification sign of design and construction indicated on drawings.
   1. Obtain and pay for any permits required for temporary signage by local authority having jurisdiction.

C. Erect on site at location(s) established by Architect.

D. Provide temporary directional signage as directed to facilitate site access for visitors and other construction personnel.

E. No other signs are allowed without Owner permission except those required by law.

1.13 FIELD OFFICES

A. Field Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture and drawing display table.
   1. Provide space for Project meetings, with table and chairs to accommodate 10 persons.
   2. Provide drinking water/water cooler and a private bathroom.
   3. Maintain the following materials in the field office, available to Architect and Owner's representative at all times:
      a. A complete, up-to-date set of all Contract Documents, including FCs, RFIs, PCOs, and COs.
      b. A complete, up-to-date set of all reviewed final shop drawings.
      c. The most recent, up-to-date version of Contractor's Progress Schedule.

B. Locate offices a minimum distance of 30 feet from other structures.

1.14 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.

B. Remove temporary underground installations.

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

2.01 MATERIALS

A. Rough Carpentry: 2x lumber, in length and depth required for floor to ceiling partitions. Partitions shall not be fastened to existing ceilings or flooring to remain. Provide additional bracing and concealed attachments to building structure.

B. Gypsum Board: 1/2-inch gypsum wallboard; ASTM C 1396.

C. Insulation: Mineral-wool fiber blankets; with maximum flame-spread and smoke-developed ratings of 25 and 50 when tested per ASTM E 84.

D. Polyethylene Sheet: Minimum 10 mil reinforced sheeting; achieving a passing rating when tested per NFPA 701, and a maximum flame-spread rating of 15 when tested per ASTM E 84.

E. Walk-Off Mats: Dust-, dirt- and silica-control walk-off mats at each entrance into the enclosed construction area and each entrance through temporary partitions.

F. Hardware: Provide temporary hinges, latch, and lock at doors in temporary partitions. Where doors in temporary partitions are also indicated to serve as egress, provide ADA-compliant exit device and closer.

2.02 EQUIPMENT

A. Fire Extinguishers: Provide portable UL rated extinguishers. Provide extinguisher types rated for potential classes of fire expected for construction work indicated.

PART 3 EXECUTION

3.01 ELEVATOR AND STAIR USAGE

A. Use of new or existing elevator(s) is not permitted.

B. Use of existing stairs is permitted. Cover existing finishes and maintain stairs without damage. Clean and restore stairs to Owner's approval at Substantial Completion.

3.02 PEST CONTROL

A. Provide pest-control services at regular intervals, performed in compliance with regulations of state regulations, and by a pest-control firm licensed in the state where the project is located. Any chemicals and pesticides used shall be approved by EPA and local authority having jurisdiction. Contractor's pest control plan shall ensure the facility is free of termites, roaches, rodents, and other pests at time of Substantial Completion.
   1. Coordinate with Owner's Integrated Pest Management (IPM) plan where applicable.
   2. Provide Owner with a minimum 72 hours pre-notification for pest-control treatments.

3.03 TEMPORARY FIRE PROTECTION

A. Comply with International Fire Code, Chapter 33 "Fire Safety During Construction and Demolition" for preventing damage to structures under construction.
   1. Comply with NFPA 241 "Standard for Safeguarding Construction, Alteration, and Demolition Operations" for additional provisions and conditions that are not covered by Chapter 33 of the International Fire Code.

B. Provide a fire-prevention program, review with all personnel on site, and post fire-prevention information in clearly visible area. Coordinate fire-prevention program with local fire department.

C. Provide clearly labeled portable fire extinguishers.

D. Provide fire watch in compliance with OSHA requirements during and after use of all potential ignition sources, including but not limited to, welders, grinders, cutting torches, heating and electrical equipment, and lighting.

E. Do not allow smoking in areas under construction.

3.04 MOISTURE CONTROL

A. Prevent the absorption of moisture and humidity 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. Provide temporary mechanical ventilation for humidity and moisture control until the building HVAC system is operational. Do not store or install material in the building until ambient temperature and humidity is within manufacturer's acceptable range. Do not install wet materials, and ensure that substrates are fully dry prior to installing other materials over them.

C. Provide continuous monitoring of installed materials. Remove gypsum board, wood products, and other mold-supporting products, if they become and remain wet for 48 hours. Remove and replace any materials showing visible signs of mold or mildew.

3.05 TEMPORARY FACILITY USAGE AND REMOVAL

A. Maintenance and Usage: Keep temporary facilities clean and in well-maintained condition for the duration of the Project. Prevent misuse of or damage to facilities by construction personnel. Make repairs to temporary facilities or replace facilities as required to keep them in good operating condition and in compliance with applicable OSHA, local permitting, and other applicable regulations.

B. Changeover: Coordinate changeover from temporary facilities to permanent facilities at Substantial Completion, unless an alternate arrangement for changeover has been agreed upon in writing by Owner.

1. Contractor shall be responsible for repair, restoration, and cleaning of permanent facilities that are used for construction purposes after changeover.

C. Removal: Unless otherwise indicated, temporary facilities and controls are the property of the Contractor, and shall be removed upon Architect's approval when Contractor can demonstrate that they are no longer needed.

1. Comply with construction waste management and recycling requirements for temporary facilities and materials that are not able to be reused.
2. After removal of temporary facilities and controls, complete all permanent construction that was not accessible due to the presence of temporary facilities.
3. Remove materials that have become soiled or contaminated due to construction vehicle traffic, parking, temporary field offices, oil or other chemical spillage, and other temporary usage, and replace with clean material. Complete grading, landscaping, paving, and other site improvements, and repair or restore all damage to existing or previously completed site improvements.

END OF SECTION 015000

SECTION 016000
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 DEFINITIONS

A. Comparable Product: An unnamed product that is similar in quality and performance to named product(s).

B. Basis-of-Design Product: A specific product selected by the Architect for use in the design process; based on certain performance characteristics, physical qualities or details, a specialized finish type, pattern, or color, or other indicated characteristics.

1.02 WARRANTIES

A. Product warranties shall be provided in addition to and run concurrently to Contractor's general warranty/guarantee.
   1. Unless otherwise indicated, all warranty terms shall start on the date of Substantial Completion.

B. Manufacturer's Warranty: A standard warranty issued by the product manufacturer, covering production and material defects.

C. Special Warranties: Warranties in addition to standard manufacturer's warranty, covering fabrication, installation, or specific performance items such as weathertightness

D. Warranty Form: Warranty shall be provided on either manufacturer's standard form or on specified form. When a sample warranty form is not included in the Project Manual, the warranty shall be on mutually agreed form.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by Contract Documents.

B. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.

C. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.

2.02 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by Contract Documents.

B. Refer to Section 014000 - Quality Requirements, for additional source quality control requirements.

C. Use of products having any of the following characteristics is not permitted:
   1. Made using or containing CFC's or HCFC's.
   2. Containing lead, cadmium, or asbestos.

2.03 PRODUCT OPTIONS

A. Products Specified with a Single Named Product: Where required by Owner due to facility standards, provide the named product; no options or substitutions allowed.

B. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

C. 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.

D. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

E. Products Specified by Naming One or More Manufacturers with a Provision for Comparable Products: Unnamed comparable product may be submitted after award of Contract. Comply with requirements in "Comparable Products" article below.

2.04 BASIS-OF-DESIGN PRODUCTS

A. Where a product is specified by naming a Basis-of-Design, comply with the following:
   1. Where a list of additional manufacturers is provided, provide the Basis-of-Design product or a comparable product by one of the listed manufacturers, in compliance with "Comparable Products" article below.
   2. Where a list of additional manufacturers is not provided, provide the Basis-of-Design product, or submit a substitution request in compliance with Section 012500 - Substitution Procedures.
   3. Basis-of-Design characteristics shall include requirements in the Specifications and on the Drawings.
   4. Where the Basis-of-Design lists a specific finish, manufacturers wishing to submit as a Comparable Product or as a substitution shall certify that they are able to provide an exact match to the specified finish, or that they will provide a custom finish to match.

2.05 COMPARABLE PRODUCTS

A. Where a product is specified with a provision for comparable products, Contractors submitting a Comparable Product shall comply with the following:
   1. The submitted product shall not require changes to the Work, unless specifically approved by Architect. If changes are required, the Contractor shall resubmit the product as a substitution request, and the Contractor shall bear the cost of the changes, coordinate with other impacted contractors, and provide appropriate notations on record documents.
   2. Contractor shall provide, with the submittal, a detailed breakdown comparing the submitted product to at least one of the other listed products; list specified performance qualities, test results, dimensions, finish, and other critical properties.
   3. Contractor shall provide warranty data indicating that submitted Comparable Product complies with indicated warranty term(s).

B. Comparable product submittals are subject to Architect's final approval. If a proposed product is found to be unacceptable, Contractor shall revert to one of the named products.

2.06 COLOR/FINISH OPTIONS

A. Preselected Color/Finish: Where a specific manufacturer's premium or custom finish or color is indicated as the basis-of-design, other listed manufacturers shall certify that they can provide an exact match, or that they will provide pricing under the assumption that a custom finish or color will be required.

B. Color/Finish Selection: Unless specifically indicated to either be a custom color or to be selected from manufacturer's standard range, color and finish selections shall be made from manufacturer's full range of options, including premiums, metallics, wood grains, etc.

2.07 MAINTENANCE MATERIALS

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

B. Deliver to location designated by Owner; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

A. Refer to Section 012500 - Substitution Procedures.

3.02 OWNER-FURNISHED PRODUCTS

A. Owner-Furnished/Contractor-Installed Products: Refer to Section 011000 - Summary and to the Drawings for identification of Owner-furnished products for installation by Contractor. Products shall be identified as "Owner-furnished" or "OF/CI".
   1. Owner's Responsibilities for Owner-Furnished/Contractor-Installed Products:
      a. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
      b. Arrange and pay for product delivery to site.
      c. On delivery, inspect products jointly with Contractor.
      d. Submit claims for transportation damage and replace damaged, defective, or deficient items.
      e. Arrange for manufacturers' warranties, inspections, and service.
   2. Contractor's Responsibilities for Owner-Furnished/Contractor-Installed Products:
      a. Review Owner reviewed shop drawings, product data, and samples.
      b. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
      c. Handle, store, install and finish products.
      d. Repair or replace items damaged after receipt.

B. Owner-Furnished/Owner-Installed Products: Where products are indicated on Drawings as "NIC", "Owner-provided", or "OF/OI", the Owner shall furnish and install the indicated products. Coordinate with Owner for expected delivery dates.
   1. The Contractor shall allow for access by Owner's personnel or designated installer as necessary.
   2. The Contractor shall not be responsible for damage to in-place construction caused during delivery/installation of Owner-Provided products.

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. Provide protection of stored materials and products against theft, casualty, or deterioration.

B. 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. Refer to Section 017419.

1. Structural Loading Limitations: Handle and store products and materials so as not to exceed static and dynamic load-bearing capacities of project floor and roof areas.

C. Store and protect products in accordance with manufacturers' instructions.

D. Store with seals and labels intact and legible.

E. Arrange storage of materials and products to allow for visual inspection for the purpose of determination of quantities, amounts, and unit counts.

F. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.

G. For exterior storage of fabricated products, place on sloped supports above ground.

H. Provide off-site storage and protection when site does not permit on-site storage or protection.

I. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

J. Comply with manufacturer's warranty conditions, if any.

K. Do not store products directly on the ground.

L. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

M. Prevent contact with material that may cause corrosion, discoloration, or staining.

N. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

O. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION 016000

SECTION 017000
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SUBMITTALS

A. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.02 QUALIFICATIONS

A. For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

1.03 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. Perform dewatering activities, as required, for the duration of the project.

E. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

F. Dust and Silica Control: Execute work by methods to minimize raising dust and silica from construction operations. Provide positive means to prevent air-borne dust and silica from dispersing into atmosphere and over adjacent property.

1. Provide dust-proof enclosures to prevent entry of dust and silica that is generated outdoors.
2. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.

G. 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.

1. Minimize amount of bare soil exposed at one time.
2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

H. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.

I. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.

J. 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.

K. Hazardous Materials: Do not use materials or products that contain hazardous substances, for permanently installed products and materials, installation materials, or for cleaning or other construction use.

1.04 COORDINATION

A. See Section 011000 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, with provisions for accommodating items installed later.

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.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.

C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 016000 - Product Requirements.

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. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.

E. Verify that utility services are available, of the correct characteristics, and in the correct locations.

F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work,

assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

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 LAYING OUT THE WORK

A. Promptly notify Architect of any discrepancies discovered.

3.04 GENERAL INSTALLATION REQUIREMENTS

A. Fire Safety: Comply with provisions of current version of the International Fire Code, Chapter 33; "Fire Safety During Construction and Demolition" for preventing damage to structures under construction.
   1. In addition to compliance with regulatory requirements, conduct construction operations in compliance with NFPA 241, including applicable recommendations in Appendix A.

B. 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.

C. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

D. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

E. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

F. Make neat transitions between different surfaces, maintaining texture and appearance.

3.05 ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
   1. Verify that construction and utility arrangements are as indicated.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of alterations work constitutes acceptance of existing conditions.

B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
   1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 015000.

C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
   1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
   2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.

D. Remove existing work as indicated and as required to accomplish new work.
   1. Remove items indicated on drawings.
   2. Relocate items indicated on drawings.

3. Remove miscellaneous hangers, exposed nails not serving as fasteners, and similar protrusions; remove adhesive residue and tape; fill anchorage holes; and otherwise patch and restore surface to be a uniform substrate.
4. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; prepare substrate per manufacturer's requirements for successful application of new finish.
5. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces.

E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
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.
a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
b. See Section 011000 for other limitations on outages and required notifications.
c. Provide temporary connections as required to maintain existing systems in service.
3. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.

F. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
a. Use cutting methods such as sawing, drilling, and grinding that do not create impact stresses on existing construction. Do not use striking methods such as chopping or hammering.
3. Repair adjacent construction and finishes damaged during removal work.

G. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect.
2. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.

H. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.

I. Refinish existing surfaces as indicated:
1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.

J. Clean existing systems and equipment in all spaces impacted by alteration work.

K. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.

L. Do not begin new construction in alterations areas before demolition is complete.

3.06 CUTTING AND PATCHING

A. Refer to Alterations article above for additional requirements related to cutting and patching of existing construction.

B. Perform cutting and patching 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 specified condition.

D. Employ skilled and experienced installer to perform cutting and patching.

E. Restore work with new products in accordance with requirements of Contract Documents.

F. Fit work to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

G. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material to maintain existing fire ratings, to full thickness of the penetrated element.

H. 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, 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.

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 and silica.

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. Protect work from spilled liquids. If work is exposed to spilled liquids, immediately remove protective coverings, dry out work, and replace protective coverings.

G. 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.

H. Prohibit traffic from landscaped areas.

I. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.09 SYSTEM STARTUP AND ADJUSTING

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.

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. Adjust operating products and equipment to ensure smooth and unhindered operation.

I. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.10 DEMONSTRATION AND INSTRUCTION

A. See Section 017900 - Demonstration and Training.

3.11 FINAL CLEANING

A. Execute final cleaning prior to Substantial Completion.
   1. Clean areas to be occupied by Owner prior to final completion before Owner occupancy.

B. Use cleaning materials that are nonhazardous.

C. 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.

D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.

E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

F. Replace 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.

3.12 CLOSEOUT PROCEDURES

A. Prior to Substantial Completion, complete the following:
   1. Provide startup, testing, and adjusting of all systems and equipment.
      a. Demonstrate that air and water systems are balanced and that automatic temperature control system is in control of all equipment. This may require separate demonstrations if controls cannot be tested for applicable seasons of the year.
      b. Submit written certification that testing/adjusting/balancing operations have been completed, and that systems are operation and under control in conformance with applicable specification section(s).
      c. Submit written certification that all Building Commissioning has been completed.
      d. Complete testing of the electronic security and detention systems and equipment, demonstrating security control.
   2. Provide all inspections required by local authorities having jurisdiction to obtain Certificate of Occupancy, and provide written certification of completion of Special Inspections.
   3. Provide preventive maintenance services for all equipment used prior to Substantial Completion, and provide initial maintenance servicing for all products and equipment that will be subject to ongoing maintenance/service contracts.
   4. Provide final cleaning of all products, materials, and equipment, and provide touch up and restoration of exposed materials and finishes.
   5. Provide fresh batteries in all battery-powered products and equipment.
   6. Provide demonstration and training for Owner's personnel on all required systems and equipment.
   7. Coordinate a walkthrough with the Owner and the local fire department and other emergency services.
   8. To the maximum extent possible, remove temporary facilities and controls, construction equipment and tools, and similar items that are not part of the finished Work.
   9. Coordinate changeover with the Owner of permanent utilities, insurance requirements, and building's permanent keying and lock system.

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

C. Submit written certification containing Contractor's Correction Punch List, 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 Substantial Completion inspection.

D. Conduct Substantial Completion inspection with representatives of Owner and Architect, and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
   1. At the Architect's sole discretion, based on the amount of outstanding work, the Architect may elect to decline to issue a Certificate of Substantial Completion and will provide a list of outstanding items that are required to obtain Substantial Completion. The Contractor shall request reinspection after the indicated items have been completed.

E. Upon approval, the Architect shall prepare and distribute Certificate of Substantial Completion, and will include a list of outstanding items and Final Correction Punch List.

F. The Owner will occupy the building after Substantial Completion, as specified in Section 011000.

G. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.

H. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.

I. Prior to final completion, complete the following:
   1. Ensure that the Certificate of Substantial Completion is fully executed by all required parties.
   2. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.
   3. Provide final pest and rodent control treatments and inspections.
   4. Remove any remaining construction equipment, tools, and materials; perform additional cleaning required due to construction activities following Substantial Completion, and leave the site prepared for Owner occupancy.
   5. Submit final demonstration and training materials and videos, as built/record documents, operation and maintenance binders, and warranty binders.
   6. Submit final application for payment.

3.13 MAINTENANCE

A. Provide service and maintenance of components indicated in specification sections.
   1. Contractor's maintenance responsibility shall be through Substantial Completion, unless a longer term is required by individual specification section.

B. Maintenance service shall not be assigned or transferred to any agent or third party without prior written consent of the Owner.

END OF SECTION 017000

SECTION 017419
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. Contractor Reporting Responsibilities: Submit periodic Waste Disposal Reports; report landfill disposal, incineration, recycling, salvage, and reuse regardless of to whom the cost or savings accrues; use the same units of measure on required reports.

E. 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.

F. 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. Fire Safety: Comply with International Fire Code, Chapter 33 "Fire Safety During Construction and Demolition" and with NFPA 241 for provisions relating to accumulation and removal of combustible debris and waste.

1.02 RELATED REQUIREMENTS

A. Section 013000 - Administrative Requirements: Additional requirements for project meetings, reports, submittal procedures, and project documentation.

B. Section 015000 - Temporary Facilities and Controls: Additional requirements related to trash/waste collection and removal facilities and services.

C. Section 016000 - Product Requirements: Waste prevention requirements related to delivery, storage, and handling.

D. Section 017000 - 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.

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. 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.
   3. 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. Incinerator Disposal: Include the following information:
      a. Identification of material.
      b. Amount, in tons or cubic yards, of trash/waste material from the project delivered to incinerators.
      c. State the identity of incinerators, total amount of fees paid to incinerator, and total disposal cost.
      d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
   5. 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.

6. 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.
7. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 WASTE MANAGEMENT PROCEDURES

A. See Section 013000 for additional requirements for project meetings, reports, submittal procedures, and project documentation.

B. See Section 015000 for additional requirements related to trash/waste collection and removal facilities and services.

C. See Section 016000 for waste prevention requirements related to delivery, storage, and handling.

D. See Section 017000 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

3.02 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. Communication: Distribute copies of the Waste Management Plan to Contractor's site superintendent, each subcontractor, Owner, and Architect.

C. 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.

D. Meetings: Discuss trash/waste management goals and issues at project meetings.
   1. Prebid meeting.
   2. Preconstruction meeting.
   3. Regular job-site meetings.

E. 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. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.

F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.

G. Recycling: Coordinate with Division 2 demolition contractor to properly identify and separate recyclables. 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.

H. Recycling of Existing Acoustical Ceiling Panels: Verify with ACP manufacturer that existing ceiling tiles can be recycled. Following verification, remove and stack ceiling tiles on pallets and wrap or band the pallet loads for pick up or delivery per recycler guidelines.
1. Coordinate with Division 2 demolition contractor.
2. Coordinate with Division 9 ACP manufacturer's recycling program; contact recycler when there is a full trailer load or approx. 30,000 square feet of removed ceiling. Coordinate with recycler to arrange pick up from the project site and transport to recycling facility at no cost.
3. If quantity to be recycled is less than 30,000 square feet, coordinate with ACP manufacturer for delivery to a consolidation point/facility at Contractor's cost.

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.

END OF SECTION 017419

SECTION 017800
CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SUBMITTALS

A. Project Record Documents: Submit documents to Architect within 15 days after the date of Substantial Completion.

B. Operation and Maintenance Data:
   1. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within 15 days after acceptance.
   2. Submit one PDF draft copy of completed documents within 15 days after the Closeout Conference. This copy will be reviewed and returned, with Architect comments. Revise content of all document sets as required prior to final submission.
   3. After revisions are complete, submit one bound hard copy and PDF electronic file of revised final documents in final form within 15 days after Substantial Completion.

C. Warranties and Bonds:
   1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 15 days after acceptance.
   2. Make other submittals within 15 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 15 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

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.
   5. Miscellaneous record submittals.

B. Ensure entries are complete and accurate, enabling future reference by Owner.
   1. Include revised Drawings reissued during Bidding and Construction.

C. Store record documents separate from documents used for construction.
   1. Keep record documents in a location accessible to Architect for periodic review and reference.
   2. Maintain in legible condition. If record document set becomes damaged or excessively dirty, transfer comments to clean set prior to submittal to Architect.

D. Record information concurrent with construction progress.

E. 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.

F. 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.

G. Miscellaneous Record Submittals: Where other specification sections require completion certifications, or closeout or record submittals, submit in a single binder organized by specification section.

3.02 ASSEMBLY OF RECORD DOCUMENTS

A. Submittal for Architect's Review:
1. Submit PDF scanned copy of marked up prints.
2. Architect shall review and provide comment on completeness

B. Submittal for Distribution to Owner:
1. After Architect has approved for content and completeness, submit PDF scanned copy of final marked up prints, and submit hard copy originals.
2. Submit full set of Drawings, regardless of whether any modification or markings are on each sheet.

3.03 OPERATION AND MAINTENANCE DATA

A. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

B. 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.

C. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.04 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.

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.

3.05 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. 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.

B. 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.

C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.

D. Include color coded wiring diagrams as installed.

E. 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.

F. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

G. Provide servicing and lubrication schedule, and list of lubricants required.

H. Include manufacturer's printed operation and maintenance instructions.

I. Include sequence of operation by controls manufacturer.

J. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

K. Provide control diagrams by controls manufacturer as installed.

L. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.

M. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

N. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

O. Include test and balancing reports.

P. Additional Requirements: As specified in individual product specification sections.

3.06 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

A. Assemble 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. Binders: 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.

D. Cover: Identify each binder on front and spine with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.

E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.

F. 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.

G. 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.

H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.

I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

J. Arrangement of Contents: Organize each volume in parts as follows:
   1. Project Directory.
   2. Table of Contents, of all volumes, and of this volume.
   3. Operation and Maintenance Data: Arranged by system, then by product category.
      a. Source data.
      b. Product data.
      c. Operation and maintenance data.
      d. Field quality control data.
      e. Photocopies of warranties and bonds.

3.07 WARRANTIES AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 15 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 are notarized.

C. Retain warranties and bonds until time specified for submittal.

D. Manual: Bind in commercial quality 8-1/2 by 11 inch three D side ring binders with durable plastic covers.

E. Cover: Identify each binder on front and spine 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.

F. 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.

G. 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.

H. Provide photocopy of each warranty in operation and maintenance manuals; locate each warranty with applicable O&M data for product or equipment.

END OF SECTION 017800

SECTION 017900
DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.01 SUMMARY

A. Demonstration of products, systems, equipment, and other items where indicated in specific specification sections.

B. Training of Owner personnel in operation and maintenance of products, systems, equipment, and as otherwise indicated in specific specification sections.

1.02 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Draft Training Plans: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
   1. Submit not less than four weeks prior to start of training.
   2. Revise and resubmit until acceptable.
   3. Provide an overall schedule showing all training sessions.
   4. Include at least the following for each training session:
      a. Identification, date, time, and duration.
      b. Description of products and/or systems to be covered.
      c. Name of firm and person conducting training; include qualifications.
      d. Intended audience, such as job description.
      e. Objectives of training and suggested methods of ensuring adequate training.
      f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
      g. Media to be used, such as slides, hand-outs, etc.
      h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.

C. Training Manuals: Provide training manual for each attendee.
   1. Include applicable portion of O&M manuals.
   2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
   3. Provide one extra copy of each training manual to be included with operation and maintenance data.

D. Training Reports:
   1. Identification of each training session, date, time, and duration.
   2. Sign-in sheet showing names and job titles of attendees.
   3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.

E. Video Recordings: Submit digital video recording of each demonstration and training session for Owner's subsequent use.
   1. Format: DVD Disc.
   2. Label each disc and container with session identification and date.

3. Where available, provide manufacturer's pre-produced training videos in conjunction with live demonstration and training video.

1.03 QUALITY ASSURANCE

A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
   1. Instructor shall be certified by the manufacturer or fabricator of system.
   2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 DEMONSTRATION - GENERAL

A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.

B. Demonstrations conducted during Functional Testing need not be repeated unless Owner personnel training is specified.

C. Demonstration may be combined with Owner personnel training if applicable, and if acceptable to Owner.

D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
   1. Complete demonstrations within two weeks after the date of Substantial Completion.
   2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

E. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
   1. Complete demonstrations within two weeks after the date of Substantial Completion.

3.02 TRAINING - GENERAL

A. Conduct training on-site, utilizing installed products and equipment, unless otherwise indicated.

B. Provide training in minimum two hour segments.

C. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.

D. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
   1. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
   2. Typical uses of the O&M manuals.

E. Product- and System-Specific Training:
   1. Review the applicable O&M manuals.
   2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.

3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
4. Discuss cleaning products and procedures, including recommended cleaning products and products that are detrimental to equipment operation or finishes.
5. Provide hands-on training on all operational modes possible and preventive maintenance.
6. Emphasize safe and proper operating requirements; discuss relevant health and safety issues, warning or error indications, and emergency procedures and shutdown.
7. Discuss common troubleshooting problems and solutions. Include minor adjustments for resolving noise, vibration, and improving system efficiency.
8. Discuss any peculiarities of equipment installation or operation.
9. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage. Include discussion of continuing maintenance agreements and procedures.
10. Review recommended tools and spare parts inventory suggestions of manufacturers.
11. Review spare parts and tools required to be furnished by Contractor.
12. Review spare parts suppliers and sources and procurement procedures.

F. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION 017900

SECTION 018119
INDOOR AIR QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Provide Indoor Air Quality (IAQ) Management Plan to remain in force during the construction period.

B. Chapter 3 of the Sheet Metal and Air Conditioning National Contractors' Association (SMACNA) IAQ Guideline for Occupied Buildings Under Construction, 2nd Edition 2007, available from SMACNA (703-803-2980 or www.smacna.org).

1.02 SUBMITTAL

A. Construction Indoor Air Quality Management Plan (CIAQM Plan).

PART 2 OBJECTIVES DURING CONSTRUCTION

2.01 PROTECTION

A. Store all materials and equipment in a protected area (inside warehouse or storage trailer). Protect materials and equipment that are too large or heavy to store in a trailer from water and dirt/dust/debris.
   1. OPTION: When stored outside, provide two layers of minimum 8-mil poly on the ground and elevate equipment or material a minimum of 4 inches to allow water to run off. Secure top and sides with two layers of 8-mil poly to prevent water penetration and dust/dirt accumulation.

B. Protect HVAC equipment from dust and odors. Do not store equipment in areas near painting, pressure washing, or excavation. Do not operate equipment during cutting or grinding of masonry or concrete.
   1. Refer to Division 23 for construction filter requirements for protection of mechanical duct systems during construction.
   2. Clean ductwork when installed. Cap ends with poly during construction to prevent contamination.
   3. Do not operate HVAC system until the exterior walls, roof, glass, doors and building filters are properly installed.
   4. If air handlers must be used during construction, provide filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 at each air-handling unit. Provide specified prefilters and final filters for operation during construction or install temporary 4-inch MERV 8 filters at each return air grille for operation during construction.
   5. Replace all filtration media immediately prior to Substantial Completion.
      a. Filtration media installed in air-handling units shall have a Minimum Efficiency Reporting Value (MERV) of 8.
   6. Do not perform Testing and Balancing until dust or odor generating activities are completed.

2.02 SOURCE CONTROL

A. Minimize IAQ contaminants introduced by construction materials.

B. Store waste construction materials a minimum of 30 feet away from the building.

C. Do not smoke within 30 feet of the exterior building perimeter.

2.03 PATHWAY INTERRUPTION

A. Provide barriers to contain construction areas to allow a portion of the building to be cleaned and then operate the HVAC system in that cleaned area. Acceptable barriers include dust curtains and temporary walls.
   1. Protect areas of the building in which HVAC is operational by physical barriers from areas of the building not acceptable for operation of the HVAC system.

B. Maintain areas within 30 feet of outdoor air intakes free of dust, dirt, debris, and volatile materials while the HVAC system is in operation.

2.04 HOUSEKEEPING

A. As dust accumulates at the Site, it can become airborne when disturbed by nearby activity. Similarly, spills or excess applications of products containing solvents will increase odors at the Site. Leaving the Site wet or damp for more than a day could result in the growth of mold and bacteria. Therefore, Site cleanup and maintenance is important to maintaining good IAQ during construction.

B. Perform the following to control contaminants at the Site:
   1. Suppress dust with wetting agents or sweeping compounds.
   2. Provide an efficient dust collection method (e.g. a damp rag, wet mop, or vacuum equipped with a high efficiency particulate arrester (HEPA) filter or wet scrubber).
   3. Remove spills or excess applications of solvent-containing products immediately. Provide low-VOC emitting spot removers and cleaning agents near occupied areas.
   4. Remove accumulated water and keep work areas as dry as possible, including the use of dehumidification, if necessary.
   5. Once building is enclosed, vacuum with HEPA filtered vacuum cleaners to prevent settled dust from becoming airborne again.
   6. Protect porous materials from exposure to moisture. Replace items that remain damp for more than four hours.

END OF SECTION 018119

SECTION 024100
DEMOLITION

PART 1 GENERAL

1.01 DEFINITIONS

A. "Remove": Carefully detach or dismantle items from existing construction and properly dispose of or recycle off site, unless items are indicated to be salvaged or reinstalled.

B. "Salvage" or "Remove and Salvage": Carefully 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. If indicated to be reinstalled, store in a secure area until ready for reinstallation.

C. "Reinstall" or "Remove and Reinstall": Carefully detach or dismantle items from existing construction in a manner to prevent damage. Clean and prepare for reuse and reinstall where indicated.

D. "Existing", "Existing to Remain" or "ETR": Designation for existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

1. Not all existing construction to remain shall be noted with one of these terms on the Drawings; the intent is to assist the Contractor in areas where it may be difficult to determine. Existing construction shall be assumed to remain unless specifically noted to be removed - either when noted with "remove", "salvage", or "reinstall" terminology per above, or when indicated graphically in accordance with the Demolition Legend on the Demolition Drawings.

1.02 REFERENCE STANDARDS

A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

1. Hold the preinstallation meeting at the Project site; perform a walkthrough to review the existing conditions and highlight areas of particular concern.
2. Review structural concerns and deficiencies in the existing building(s).
3. Review demolition schedule.
4. Review specific elements indicated to remain or to be salvaged, and review procedures for protection and / or storage of those elements.
5. Review Owner's occupancy and noise requirements.

B. Coordination: Coordinate staging requirements with Owner's occupancy of the existing building.

1. Coordinate with Division 01 sections for Owner's occupancy and noise requirements.
2. Owner's personnel shall remove existing equipment and furnishings from spaces to be demolished prior to the beginning of the Work. Except for any built-in equipment specifically indicated on the Drawings to remain and be protected, the Contractor will not be required to work in furnished areas and will not be responsible for the condition of furniture or equipment left in place.

1.04 SUBMITTALS

A. Photographic Documentation: Submit photographic record of the existing conditions, either as still photographs or as a video-recorded walkthrough. Contractor shall perform walkthrough of

existing conditions with Owner's representative prior to site mobilization.

1. Photographic documentation shall clearly show existing damage and wear on existing surfaces that may be interpreted as being caused by subsequent demolition and construction operations.
2. For still photographs, submit marked-up plan(s) indicating locations where photographs were taken and direction photograph is facing. Include a written narrative to describe existing damage and other conditions as deemed necessary.
3. For video recordings, include a spoken narrative to describe locations and existing conditions, or provide a supplementary written narrative.
4. Submit all photographic documentation as digital photo / video files, and supplementary narratives and plans as PDF files. Submit as part of the initial submittal package required prior to release of the first request for payment.

B. Shop Drawings: Submit demolition plans and survey as required by OSHA and local AHJs.
1. Engineering Survey: Provide structural survey of existing building(s). Provide additional surveys if unforeseen conditions are revealed during the course of the Work.
2. Indicate extent of demolition, removal sequencing, bracing and shoring, and location and construction of barricades and fences.
3. Indicate elements to be salvaged and elements that are to remain in place and protected.

C. Refrigerant Certification: Provide a written statement, signed by refrigerant recovery technician, certifying that refrigerant materials were recovered in accordance with EPA regulations. Statement shall include certified technician's full name and business name as applicable, address, and date of recovery.

D. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.05 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Technicians removing or disposing of any equipment or appliance containing ozone-depleting refrigerants shall be certified in accordance with EPA Section 608 Technician Certification.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 EXAMINATION

A. Perform an initial walkthrough and visual survey of the existing building(s). Take photographic documentation of the existing conditions per submittal requirements above.

B. Perform structural engineering survey of the existing conditions as required by OSHA and local AHJs.

3.02 PREPARATION

A. Remove and salvage items indicated to be reinstalled or turned over to Owner. Clean items and protect in secure packaging, and store in a secure location on-site.

3.03 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. All demolition work shall be considered unclassified. Barring discovery of hazardous materials or undocumented structural components, where elements are indicated to be demolished, the bid price shall be for complete demolition of the element, regardless of the individual

component makeup of that element.

B. Refrigerant Recovery: Certified recovery technician shall remove refrigerant from all applicable equipment and appliances prior to the start of demolition activities.

C. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Fire Safety: Comply with applicable requirements of the International Fire Code; Chapter 33, and with NFPA 241.
      a. Use of explosives is not permitted.
      b. Hot Work: Remove all combustibles from areas where hot work is required, including use of cutting torches, welding, or heating equipment. Maintain fire watch for entire duration of hot work and for a minimum 30 minutes after completion of hot work.
         1) Keep portable fire extinguishers within 30 feet of locations where hot work is being performed for entire duration.
      c. Maintain egress routes and emergency access routes at all times; do not allow demolished materials to accumulate and block routes.
      d. Remove combustible demolished materials from the building by the end of each work day. Temporarily store combustible materials in noncombustible containers with self-closing lids until they can be removed from the building.
      e. Do not burn demolished material on site.
   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.

D. Do not begin removal until receipt of notification to proceed from Owner.

E. Do not begin removal until built elements to be salvaged, relocated, or reinstalled have been removed.

F. 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.

G. 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.

H. Perform demolition in a manner that maximizes salvage and recycling of materials.
   1. Comply with requirements of Section 017419 - Construction Waste Management and Disposal.
   2. Dismantle existing construction and separate materials.

3. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

I. If items of potential historic interest are discovered during the course of the Work, such as cornerstones or plaques, consult with the Owner prior to proceeding. If Owner wishes to preserve these items, carefully remove and salvage, and store in on-site location designated by Owner.

3.04 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.

3.05 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. Separate areas in which demolition is being conducted from areas that remain occupied.
   1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 015000 in locations indicated on drawings.

C. Maintain weatherproof exterior building enclosure, except for interruptions required for replacement or modifications; prevent water and humidity damage.

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.

E. Remove existing work as indicated and required to accomplish new work.
   1. Remove items indicated on drawings.

F. Services (Including but not limited to HVAC, Plumbing, Fire Protection, 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. Coordinate with Section 011000 - Summary for limitations on outages and required notifications to Owner, as applicable.
4. Verify that abandoned services serve only abandoned facilities before removal.
5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings. Remove back to source of supply where possible, otherwise cap stub and tag with identification.

G. Floor Finishes: After removal of existing floor finishes including backings, underlayments, and thick set mortar beds, remove all residual adhesives and glue. Provide grinding, sanding, or shot-blasting of existing concrete floor slab to achieve the proper surface to receive new indicated floor finish. Coordinate slab surface preparations required for each new indicated floor finish with appropriate subcontractor.

H. Acoustical Ceiling Panels: Coordinate with Division 9 acoustical ceiling panel manufacturer and Division 1 Construction Waste Management section. Remove ceiling tiles and stack neatly on pallets; wrap or band pallet loads. Store in a protected, dry location in preparation for delivery to recycling facility.

I. Concrete: Cut neatly in straight lines with power-driven saw with diamond-tooth blade or other type specifically intended for concrete and masonry. Break up and remove carefully, avoiding damage to adjacent flooring that will remain exposed in the finished work.

J. Masonry: Remove masonry in whole units at exposed surfaces, new openings, and unless otherwise indicated, to allow for toothing-in of new masonry.
   1. Solid masonry may be cut with power saw where masonry edges will be concealed by the finished work. Do not cut hollow masonry.

K. Existing Surfaces to Receive Finishes: Remove miscellaneous hangers, exposed nails not serving as fasteners, and similar protrusions; remove adhesive residue and tape; fill anchorage holes; and otherwise patch and restore surface to be a uniform substrate suitable for applied finishes.

3.06 DEBRIS AND WASTE REMOVAL

A. Comply with requirements of 017419 - Construction Waste Management and Disposal.

B. Remove all debris, trash, and other materials not indicated to be salvaged or reinstalled from the site.

C. Leave site in clean condition, ready for subsequent work.

D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION 024100

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
   1. Slabs-on-grade.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 ACTION SUBMITTALS

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

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
   1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.
   1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.

E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
   1. Location of construction joints is subject to approval of the Architect.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installer, manufacturer, testing agency.

B. Welding certificates.

C. Material Certificates: For each of the following, signed by manufacturers:
   1. Cementitious materials.
   2. Admixtures.

3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Waterstops.
7. Curing compounds.
8. Floor and slab treatments.
9. Bonding agents.
10. Adhesives.
11. Vapor retarders.
12. Semirigid joint filler.
13. Joint-filler strips.
14. Repair materials.

D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

F. Field quality-control reports.

G. Minutes of preinstallation conference.

H. Quality Control at Epoxy Terrazzo Substrates: Contractor shall establish and provide written quality control concrete slab finishing procedures reviewed by and acceptable to the (096623) epoxy terrazzo flooring manufacturer for (slab on grade) slab areas to receive epoxy terrazzo flooring to maintain the 1/8-inch in 10'-0" tolerance specified. Reduce high spots by approved mechanical means such as shot blast or special grinder. Fill low slab areas with cementitious or epoxy leveling compound acceptable to epoxy terrazzo flooring manufacturer and compatible with epoxy resin to attain level substrate for epoxy terrazzo work. Before concrete slab installation at epoxy terrazzo flooring areas, the General Contractor and installer shall review all screed elevations and spacing, extent of slab pour to help assure quality, and special conditions such as interface to stairs, elevator entrance thresholds and edge of slabs to minimize miscellaneous cracks.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."

F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specifications for Structural Concrete."
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

H. Preinstallation Conference: Conduct conference at Project site.
1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete subcontractor.
e. Special concrete finish subcontractor.
2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, vapor-retarder installation, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
   a. High-density overlay, Class 1 or better.
   b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
   c. Structural 1, B-B or better; mill oiled and edge sealed.
   d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

D. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
   1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

E. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
   1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
   2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
   3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade, deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

C. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.

D. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire or plastic and as follows:
   1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I, Type II or Type I/II. Supplement with the following:
   a. Fly Ash: ASTM C 618, Class F.
   b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Silica Fume: ASTM C 1240, amorphous silica.

C. Normal-Weight Aggregates: ASTM C 33. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 1 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Water: ASTM C 94/C 94M and potable.

2.5 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.6 FIBER REINFORCEMENT

A. Synthetic Macro-Fiber: Polyolefin macro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1 to 2-1/4 inches long.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. 3M; Scotchcast Polyolefin Fibers.
   b. Euclid Chemical Company (The), an RPM company; Tuf-Strand SF.
   c. FORTA Corporation; FORTA FERRO.
   d. Grace Construction Products, W. R. Grace & Co.; Strux 90/40.
   e. Nycon, Inc.; XL.
   f. Propex Concrete Systems Corp.; Fibermesh 650.
   g. Sika Corporation; Sika Fiber.

2.7 VAPOR BARRIERS

A. Sheet Vapor Barrier: ASTM E 1745, Class A, with a permeance of less than 0.01 perms after mandatory conditioning (ASTM E1745, Section 7.1). Include manufacturer's recommended mastic, pressure-sensitive tape, and accessory materials.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Fortifiber Building Systems Group; Moistop Ultra 15.
   b. Reef Industries, Inc.; Griffolyn 15 mil Green.
   ~~c.~~ Stego Industries, LLC; Stego Wrap 15 mil Class A

B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inchsieve and 0 to 5 percent passing a No. 8 sieve.

2.8 LIQUID FLOOR TREATMENTS

A. VOC Content: Liquid floor treatments shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

2.9 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

F. Terrazzo Floor Areas: Do not use curing agents in areas to receive terrazzo flooring.

2.10 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

B. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

C. Reglets: Fabricate reglets of not less than 0.022-inch thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

D. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.11 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4000 psi at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.12 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25 percent.
2. Ground Granulated Blast-Furnace Slag: 25 percent.

C. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use high-range water-reducing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

2.13 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: As indicated.
   2. Slump Limit: 4 inches, or 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.

B. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: As indicated.
   2. Slump Limit: 4-5 inches.
   3. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

C. Suspended Slabs on Steel Deck: Proportion light-weight concrete mixture as follows:
   1. Minimum Compressive Strength: As indicated.
   2. Slump Limit: 5 inches, plus or minus 1 inch.
   3. Maximum Water/Cement Ratio: As indicated.
   4. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 4 lb/cu. yd.
   5. Air content: 4%-7% to comply with UL for fire rated floors.

D. Elevated formed slabs and beams: Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: As indicated.
   2. Slump Limit: 4 inches, or 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture.
   3. Maximum Water/Cement Ratio: As indicated.

E. Formed walls: Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: As indicated.
   2. Slump Limit: 4 inches, or 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture.
   3. Maximum Water/Cement Ratio: As indicated.

F. Air Content: Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 6% with a tolerance of plus 1 or minus 1.5 percent, for exterior concrete only, unless otherwise indicated.

2.14 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.15 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and furnish batch ticket information.
   1. When air temperature is between 85 and 90 deg , reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Construct forms tight enough to prevent loss of concrete mortar.

D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
   1. Install keyways, reglets, recesses, and the like, for easy removal.
   2. Do not use rust-stained steel form-facing material.

E. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

F. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

G. Chamfer exterior corners and edges of permanently exposed concrete.

H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 VAPOR BARRIERS

A. Sheet Vapor Barriers: Place, protect, and repair sheet vapor barrier according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturer's recommended tape. Seal to all penetrations and vertical surfaces.

3.5 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.6 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

C. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.

2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.

3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

D. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

E. Terrazzo Coordination: Locate construction joints at terrazzo floor areas to align with joint and divider locations indicated on terrazzo floor pattern drawing, as approved.

3.7 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.8 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.9 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.

1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings and to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces indicated, to surfaces to receive trowel finish and to surfaces to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces indicated and to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
    a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17. (F(L) not required at elevated slabs).
    b. At areas receiving a terrazzo floor finish, specified overall values of flatness, F(F) 35; and of levelness, F(L) 35; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 24. F(L) not required at elevated slab).
    c. At elevated slabs supporting cells, specified overall values of flatness, F(F) 50; and of levelness F(L) 35; with minimum local values of flatness, F(F) 40; and of levelness, F(L) 24. F(L) not required at elevated slabs.
    d. At areas receiving a polished concrete floor finish, specified overall values of flatness, F(F) 50; and of levelness, F(L) 35; with minimum local values of flatness, F(F) 40; and of levelness, F(L) 24. F(L) not required at elevated slabs.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated and to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.10 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Minimum Compressive Strength: 3500 psi at 28 days.
3. 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.

4. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete substrate.
5. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
6. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.11 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
   1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
      a. Water.
      b. Continuous water-fog spray.
      c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
   2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
      a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
      b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
      c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
   3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

5. Polished Concrete:
   a. Polished concrete shall be moisture cured as detailed above. Curing compounds are not permitted.

6. Terrazzo Floor Areas:
   a. At areas to receive terrazzo flooring, cure concrete for a minimum of 28 days. Do not use curing agents in areas to receive terrazzo flooring.

3.12 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
   1. Defer joint filling until concrete has aged at least six month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.13 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
   1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
   2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inchclearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.14 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:

1. Steel reinforcement placement.

2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
6. Compression Test Specimens: ASTM C 31/C 31M.
   a. Cast and laboratory cure one set of five standard cylinder specimens for each composite sample.
7. Compressive-Strength Tests: ASTM C 39/C 39M; test one laboratory-cured specimen at 7 days and one set of three specimens at 28 days and hold one specimen for test at 56 days.
   a. A compressive-strength test shall be the average compressive strength from a set of three specimens obtained from same composite sample and tested at age indicated.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
9. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that temperature, batch to placement time, slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

D. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

END OF SECTION 033000

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Structural steel.
   2. Grout.

B. Related Requirements:
   1. Section 055000 "Metal Fabrications" miscellaneous steel fabrications and other steel items not defined as structural steel.

1.3 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

B. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.4 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Contractor shall conduct conference at the Project site.
   1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for inspecting the work.
      c. Steel erector.
      d. Architect/EOR.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Identify members and connections of the Seismic-Load-Resisting System.
6. Indicate locations and dimensions of protected zones.
7. Identify demand critical welds.

C. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and fabricator.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural steel, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Shop primers.
2. Non-shrink grout.

F. Source quality-control reports.

G. Field quality-control and special inspection reports.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172).

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector.

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

1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by

AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

D. Comply with applicable provisions of the following specifications and documents:
   1. AISC 303.
   2. AISC 341 and AISC 341s1.
   3. AISC 360.
   4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
   1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
   1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
   2. Clean and relubricate bolts and nuts that become dry or rusty before use.
   3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.
   1. Select and complete connections using schematic details indicated and AISC 360.
   2. Use Allowable Stress Design; data are given at service-load level.

B. Moment Connections: Type FR, fully restrained.

C. Construction: Combined system of braced frame and shear walls.

D. Recycled Content: Provide products with a minimum post-consumer recycled content of 75%.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992/A 992M, Grade 50.

B. Channels, Angles-Shapes: ASTM A 36/A 36M.

C. Plate and Bar: ASTM A 572/A 572M.

D. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade C, structural tubing.

E. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.

B. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy-hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends; ASTM A 563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 490, compressible-washer type with plain finish.

C. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip zinc coating.
2. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with mechanically deposited zinc coating finish.

D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1,round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Plain.

E. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

F. Unheaded Anchor Rods: ASTM F 1554, Grade 36

1. Configuration: Straight.
2. Nuts: ASTM A 563 heavy-hex carbon steel.
3. Plate Washers: ASTM A 36/A 36M carbon steel.
4. Washers: ASTM F 436, Type 1, hardened carbon steel.
5. Finish: Plain.

G. Threaded Rods: ASTM A 36/A 36M.

1. Nuts: ASTM A 563 heavy-hex carbon steel.
2. Washers: ASTM F 436, Type 1, hardened carbon steel.
3. Finish: Plain.

H. Clevises: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.

I. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.

J. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.

2.4 PRIMER

A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Primer: Comply with Division 9.

C. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

D. Galvanizing Repair Paint: ASTM A 780/A 780M.

2.5 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.6 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.
   1. Camber structural-steel members where indicated.
   2. Fabricate beams with rolling camber up.
   3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
   4. Mark and match-mark materials for field assembly.
   5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
   1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 2, "Hand Tool Cleaning."

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
   1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
   2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.

3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.7 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
   1. Joint Type: as indicated.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.8 SHOP PRIMING

A. Shop prime steel surfaces except the following:
   1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
   2. Surfaces to be field welded.
   3. Surfaces of high-strength bolted, slip-critical connections.
   4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
   5. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
   1. For Concealed Steel:
      a. SSPC-SP 2, "Hand Tool Cleaning."
      b. SSPC-SP 3, "Power Tool Cleaning."
   2. For Exposed Steel:
      a. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
   2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

D. Painting: Prepare steel and apply a one-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils (0.038 mm).

2.9 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
   1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Bolted Connections: Inspect and test shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

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

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Baseplates and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate where indicated.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   1. Level and plumb individual members of structure.
   2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened, unless noted otherwise.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
   2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
   3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
   1. Verify structural-steel materials and inspect steel frame joint details.
   2. Verify weld materials and inspect welds.
   3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Bolted Connections: Inspect and test bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.
   1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
      a. Liquid Penetrant Inspection: ASTM E 165.

b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
c. Ultrasonic Inspection: ASTM E 164.
d. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

C. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

D. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

END OF SECTION 051200

SECTION 054000 - COLD-FORMED STEEL FRAMING – STRUCTURAL (CFSF-S)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Exterior non-load-bearing wall framing.
   2. Interior non-load-bearing wall framing indicated as CFSF-S
   3. Soffit framing.
   4. Bulkhead framing.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for inspecting the work.
      c. CFSF installer.
      d. Architect/EOR.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of cold-formed steel framing product and accessory.

B. Shop Drawings:
   1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
   2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
   3. Calculations prepared by an engineer licensed in the state of North Carolina.

C. Delegated-Design Submittal: For cold-formed steel framing.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency.
   1. Steel sheet.
   2. Power-actuated anchors.

3. Mechanical fasteners.
4. Vertical deflection clips.
5. Horizontal drift deflection clips
6. Miscellaneous structural clips and accessories.

D. Evaluation Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

D. Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing – General Provisions."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. AllSteel Products, Inc.
2. Clark Steel Framing.
3. Consolidated Fabricators Corp.; Building Products Division.
4. Craco Metals Manufacturing, LLC.
5. Custom Stud, Inc.
6. Formetal Co. Inc. (The).
7. MarinoWare; a division of Ware Industries.
8. SCAFCO Corporation.
9. Southeastern Stud & Components, Inc.
10. Steel Construction Systems.
11. United Metal Products, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated.

2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
   a. Exterior Non-Load-Bearing Framing: Horizontal deflection of l/360 of the wall height. Maximum horizontal deflection of l/600 of the wall height where supporting brick or limestone veneer or similar veneers that are prone to damage under small deflections.
   b. Interior Non-Load Bearing Framing indicated as CFSF-S: Horizontal deflection of l/360 under a horizontal load of 5 lbf/sq. ft.
3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
   a. Upward and downward movement of 1 inch.
5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing Design Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:
1. Floor and Roof Systems: AISI S210.
2. Wall Studs: AISI S211.
3. Headers: AISI S212.
4. Lateral Design: AISI S213.

D. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

E. Recycled Content: Provide products with a minimum post-consumer recycled content of 25%.

2.3 COLD-FORMED STEEL FRAMING, GENERAL

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
1. Grade: As required by structural performance.
2. Coating: G60.

B. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
1. Grade: As required by structural performance.
2. Coating: G90.

2.4 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0428 inch.
   2. Flange Width: 1-5/8 inches.
   3. Depth: 8 inches, unless noted otherwise.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0428 inch.
   2. Flange Width: 1-1/4 inches.

C. Vertical Deflection Clips: Manufacturer's standard head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
   1. Minimum Base-Metal Thickness: 0.0677 inch.
   2. Flange Width: 1 inch (25 mm) plus the design gap for one-story structures.

E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
   1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
      a. Minimum Base-Metal Thickness: 0.0677 inch.
      b. Flange Width: 1 inch plus the design gap for one-story structures.
   2. Inner Track: Of web depth indicated, and as follows:
      a. Minimum Base-Metal Thickness: 0.0677 inch.
      b. Flange Width: Dimension equal to sum of outer deflection track flange width plus 1 inch.

F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.5 INTERIOR NON-LOAD-BEARING WALL FRAMING DESIGNATED AS CFSF-S

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows.
   1. Minimum Base-Metal Thickness: 0.0428 inch.
   2. Flange Width: 1-5/8 inches.
   3. Depth: 3-5/8 inches, unless noted otherwise.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0428 inch.
   2. Flange width: 1-1/4 inches.

C. Vertical Deflection Clips: Manufacturer's standard clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

2.6 SOFFIT FRAMING

A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0428.
   2. Flange Width: 1-5/8 inches, minimum.
   3. Depth: 3-5/8 inches, minimum.

2.7 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
   1. Supplementary framing.
   2. Bracing, bridging, and solid blocking.
   3. Web stiffeners.
   4. Anchor clips.
   5. End clips.
   6. Foundation clips.
   7. Gusset plates.
   8. Stud kickers and knee braces.
   9. Joist hangers and end closures.
   10. Hole reinforcing plates.
   11. Backer plates.

2.8 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

C. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
   1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

D. Welding Electrodes: Comply with AWS standards.

2.9 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A 780.

B. Shims: Load bearing, high-density multi-monomer plastic, and non-leaching; or of cold-formed steel of same grade and coating as framing members supported by shims.

C. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.10 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
    a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.
4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Install load bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.

B. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
    a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Division 07, in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

J. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: 16 inches, unless noted otherwise.

C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.
2. Install double deep-leg deflection tracks and anchor outer track to building structure.
3. Connect vertical deflection clips to studs and anchor to building structure.
4. Connect drift clips to cold-formed metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 18 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
   a. Install solid blocking at centers indicated on Shop Drawings.
2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 INTERIOR NON-LOAD BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: 16 inches, unless noted otherwise.

C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
   1. Install single deep-leg deflection tracks and anchor to building structure.
   2. Install double deep-leg deflection tracks and anchor outer track to building structure.
   3. Connect vertical deflection clips to studs and anchor to building structure.
   4. Connect drift clips to cold-formed steel metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
   1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
   2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
   3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 18 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
   1. Install solid blocking at centers indicated on Shop Drawings.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.6 ERECTION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
   1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.7 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 055000
METAL FABRICATIONS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

D. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.

E. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.

F. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

H. 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.

I. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification.

J. AWS D1.1/D1.1M - Structural Welding Code - Steel.

K. AWS D1.2/D1.2M - Structural Welding Code - Aluminum.

L. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic).

1.02 SUBMITTALS

A. Product Data: Provide product data for factory fabricated products and accessory materials, including the following:
   1. Stair nosings.
   2. Nonslip finishes.
   3. Nonshrink grout.
   4. Shop primer paint products.
      a. Coordinate with Division 9 Painting topcoat manufacturer and provide compatibility certificates from topcoat manufacturer that shop primers are acceptable substrate for specified topcoats.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   1. Include field measurements, and indicate where field measurements differ from documents.
   2. Design data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer.

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.

1.03 QUALITY ASSURANCE

A. Design mechanical supports and miscellaneous steel shapes 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. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.2/D1.2M and dated no more than 12 months before start of scheduled welding work.

C. Field Measurements: Take field measurements prior to fabrication and verify that dimensions and tolerances are acceptable for fabricated products to fit the space. Indicate field measurements on shop drawings.

PART 2 PRODUCTS

2.01 GENERAL

A. Materials, General: Provide metal fabrications and components with finished surfaces that are smooth and flat. Metal fabrications and components shall not have labels, stickers, engraved or rolled manufacturer names, seams, or blemishes that are exposed in the finished work.

2.02 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.

B. Steel Tubing: ASTM A500/A500M Grade B cold-formed structural tubing.

C. Plates: ASTM A283/A283M.

D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.

E. Slotted Channel Fittings: ASTM A1011/A1011M.

F. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.

1. Provide stainless steel fasteners for all exterior construction and for fastening aluminum and stainless steel fabrications.
2. Provide stainless steel fasteners at areas subject to moisture or steam, including mechanical rooms, janitor/custodial rooms with floor sinks, and similar spaces.
3. Provide zinc-plated fasteners for interior construction except where stainless steel is indicated.

G. Bolts, Nuts, and Washers: ASTM A307, Grade A, galvanized to ASTM A153/A153M where connecting galvanized components.

H. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

I. Shop and Touch-Up Primer: SSPC-Paint 15, universal shop primer, complying with VOC limitations of authorities having jurisdiction.

J. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

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. 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.

D. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.04 FABRICATED ITEMS

A. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking and masonry; prime paint finish.

B. Lintels: As detailed; prime paint finish.

C. Slotted Channel Framing: Fabricate channels and fittings from ASTM A1011/A1011M, Grade 33 structural steel complying with the referenced standards; with factory-applied, rust-inhibiting thermoset acrylic enamel finish.

1. Provide 1-5/8 inch by 1-5/8 inch channel unless otherwise indicated.

D. Miscellaneous Steel Shapes: Provide steel shapes for miscellaneous applications indicated on drawings, including but not limited to, reinforcing steel shapes at low partitions/knee walls and concrete slab edge angles.

2.05 FINISHES - STEEL

A. Prime paint steel items.

1. Exceptions: Galvanize and do not prime items to be embedded in concrete and items to be embedded in masonry. Do not prime items to be embedded in sprayed fireproofing.

B. Prepare interior items to be primed in accordance with SSPC-SP3 Power Tool Cleaning.

C. Prepare exterior items to be primed, and interior items to receive specialty protective coating such as zinc-rich primer, in accordance with SSPC-SP 6/NACE No. 3 Commercial Blast Cleaning.

D. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

E. Prime Painting: One coat.

F. Galvanizing: Galvanize after fabrication to ASTM A123/A123M requirements.

G. Slotted Channel Framing: ASTM A1011/A1011M Grade 33; coated with manufacturer's standard rust-inhibitive acrylic enamel.

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. Furnish 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. Perform field welding in accordance with AWS D1.1/D1.1M.

D. Obtain approval prior to site cutting or making adjustments not scheduled.

E. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

F. Installation of Nosings: Center nosings on stair width with 4 inch inset at each end. Embed nosings in wet concrete, flush to top of each tread and aligned to front edge of each riser. Coordinate with concrete installer to tool concrete around the nosings for a smooth, clean finish. Remove protective masking tape after concrete has set and cured and clean any concrete residue.

G. Installation of Bollards: Anchor bollards in concrete footings to a minimum depth of 36 inches with 6 inches of concrete below bottom of bollards. Fill bollards with concrete.

1. At Contractor's option, provide either precast caps secured to wet concrete fill, or field-mound wet concrete fill to form a rounded cap.

H. Installation of Gates: Anchor gate posts in concrete footings, to a minimum depth of 36 inches with 6 inches of concrete below bottom of posts.

1. Install gate leaf assemblies to smoothly operate without sagging or binding.
2. Install all hardware for proper operation. Drill cores into concrete apron and install cane bolt receiver sleeves into cores flush with grade. Fill spaces around gate posts and cane bolt receivers with non-shrink grout.

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.

END OF SECTION 055000

SECTION 061000
ROUGH CARPENTRY

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.

B. ASTM D2898 - Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

D. AWPA U1 - Use Category System: User Specification for Treated Wood.

E. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.

F. EPA (TSCA); Title VI - Toxic Substances Control Act, Title VI: Formaldehyde Standards for Composite Wood Products.

G. PS 20 - American Softwood Lumber Standard.

H. SCAQMD 1168 - Adhesive and Sealant Applications.

1.02 SUBMITTALS

A. Product Data: Provide technical data for fire-retardant materials, wood preservative materials, and include certification that materials and treatment comply with manufacturer's requirements.

1. Evaluation Reports: Provide ICC-ES evaluation reports for each applicable item below:
    a. Preservative-treated lumber.
    b. Fire-retardant-treated lumber.
    c. Each type of engineered wood.
    d. Each type of power- or powder-actuated fastener and expansion anchor.
    e. Structural wood connectors (framing anchors).

1.03 QUALITY ASSURANCE

A. Testing Agency Qualifications (for Fire-Retardant Treatments): Independent firm specializing in performing testing of treatments of type specified in this section, and performing periodic inspections to ensure that the material receiving the classification marking matches the tested material; and approved by local authority having jurisdiction.

1.04 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.

1. Grading Agencies: 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.
    a. Northeastern Lumber Manufacturer's Association (NELMA) - Spruce-Pine-Fir.
    b. Southern Pine Inspection Bureau (SPIB) - Southern Pine.
    c. West Coast Lumber Inspection Bureau (WCLIB) - Douglas Fir, Hem Fir, Spruce-Pine-Fir-South.
    d. Western Wood Products Association (WWPA) - Douglas Fir, Hem Fir; Spruce-Pine-Fir-South.
    e. National Lumber Grades Authority (NLGA) - Douglas Fir-North, Hem Fir-North, Spruce-Pine-Fir.
2. Provide lumber stamped with grade mark of responsible grading agency, unless otherwise indicated.
    a. Place grade stamp on unexposed surface of lumber specified to be exposed with natural or stained finish, or omit grade stamp and submit documentation from grading agency certifying grade compliance.
3. Species and Grade:
    a. Species and grade is indicated on Structural Drawings for studs, joists, rafters, beams, columns, ceiling joists, and other structural components, as applicable.
    b. For miscellaneous lumber including non-structural miscellaneous framing, blocking, nailers, grounds, and furring, provide No. 2 or Standard grade.
    c. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.
4. Moisture Content: S-dry or MC19 (19% or less). Applies to lumber for 2-inch nominal thickness and less.

B. Composite Wood: Any composite wood materials installed inside the weatherproofing system shall meet either EPA (TSCA); Title VI for ultra-low-emitting formaldehyde or no added formaldehyde (ULEF / NAUF).

2.02 ACCESSORIES

A. Fasteners and Anchors:
1. Metal and Finish: Provide hot-dipped galvanized steel complying with ASTM A 153 or stainless steel at exterior, high humidity, and preservative-treated wood locations.
    a. Fasteners at interior FRT shall be per FRT treatment manufacturer's recommendations.
2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
3. Anchors: Toggle bolt type for anchorage to hollow masonry.

B. Flexible Flashing/Separation Material: Barrier sheet fabricated of polyethylene backed rubberized asphalt or butyl rubber sheet; not less than 25 mil overall thickness.

C. General Purpose Construction Adhesives: Comply with ASTM C557 or ASTM D3498.
1. Adhesives: Adhesives field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with CAL (CDPH SM) AND shall meet the chemical content requirements of SCAQMD 1168.

2.03 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. Fire-Retardant Treated Wood: Provide FRT lumber and plywood stamped with name and mark of qualified testing agency, fire-retardant treatment product and manufacturer, wood species and drying method, testing standards, and flame spread and smoke development indices.
      a. For exterior FRT and FRT that will be exposed to moisture, include accelerated weathering test language, with the words "No increase in the listed classification when subjected to Standard Rain Test ASTM D2898".
   2. 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.

B. Fire Retardant Treatment:
   1. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 and maximum smoke developed index of 450, when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
      a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
      b. Treat interior concealed blocking, plywood backing panels, and other rough carpentry items as indicated.
      c. Do not use treated wood in applications exposed to weather or where the wood may become wet.
   2. Strength Adjustments (Structural Panels/Plywood): Test FRT structural panels/plywood per ASTM D 5516 and develop strength adjustment factors per ASTM D 6305.
   3. Strength Adjustments (Lumber): Test FRT lumber per ASTM D 5664 and develop strength adjustment factors per ASTM D 6841.

C. Preservative Treatment:
   1. Restrictions: Do not use lumber or plywood treated with chromated copper arsenate (CCA). Do not use lumber or plywood treated with inorganic boron (SBX) for applications exposed to water, ground/soil contact, or interior floor slabs/concrete. Comply with additional treatment restrictions as required by local authorities having jurisdiction.
   2. Preservative Pressure Treatment of Lumber & Plywood Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
      a. Use Category UC2 is acceptable for interior lumber and plywood above grade (not in contact with floor slab).
      b. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
      c. Treat lumber exposed to weather.
      d. Treat lumber in contact with roofing, flashing, or waterproofing.
      e. Treat lumber in contact with masonry or concrete.
      f. Treat lumber less than 18 inches above grade, and lumber located directly against below-grade exterior walls.
      g. Treat lumber in other locations as indicated.

3. Preservative Pressure Treatment of Lumber in Contact with Ground/Soil: AWPA U1, Use Category UC4A, Commodity Specification A using waterborne preservative.
   a. Preservative for Field Application to Cut Surfaces: As recommended by manufacturer of factory treatment chemicals for brush-application in the field.

PART 3 EXECUTION

3.01 PREPARATION

A. 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 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 metal-framed walls, provide continuous FRT blocking around door and window openings for anchorage of frames, securely attached to stud framing.

C. In metal-framed 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 PPT blocking is indicated to be installed directly adjacent to metal decking or other galvanized metals, provide flexible flashing/separation material as a continuous barrier to prevent direct contact between materials.

3.04 CLEANING

A. Waste Disposal: Refer to Section 017419 - Construction Waste Management and Disposal.
   1. Comply with applicable regulations.
   2. Do not burn scrap on project site.
   3. Do not burn scraps that have been pressure treated.
   4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.

C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION 061000

SECTION 064100
ARCHITECTURAL WOODWORK AND CASEWORK

PART 1 GENERAL

1.01 DEFINITIONS

A. Exposed: Portions of casework visible when drawers and cabinet doors are closed, including end panels, bottoms of cases more than 42 inches above finished floor, tops of cases less than 72 inches above finished floor and all members visible in open cases or behind glass doors.

B. Semi-Exposed: Portions of casework and surfaces behind solid doors, tops of cases more than 72 inches above finished floor and bottoms of cabinets more than 30 inches but less than 42 inches above finished floor.

C. Concealed: Sleepers, web frames, dust panels and other surfaces not generally visible after installation and cabinets less than 30 inches above finished floor.

1.02 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard.

B. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications.

C. ANSI A208.1 - American National Standard for Particleboard.

D. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

F. AWI (QCP) - Quality Certification Program.

G. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition.

H. BHMA A156.9 - Cabinet Hardware.

I. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.

J. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board.

K. EPA (TSCA); Title VI - Toxic Substances Control Act, Title VI: Formaldehyde Standards for Composite Wood Products.

L. NEMA LD 3 - High-Pressure Decorative Laminates.

M. SCAQMD 1113 - Architectural Coatings.

N. SCAQMD 1168 - Adhesive and Sealant Applications.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

1.04 SUBMITTALS

A. Product Data: Component dimensions, configurations, construction details, joint details, attachments.

1. Include product data for each type of hardware and accessory.

B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.

1. Include field measurements, and indicate where field measurements differ from documents.

C. Selection Samples: Submit manufacturer's color charts indicating full range of available colors, for each product requiring color selection.

D. Verification Samples: Submit physical samples, manufacturer's standard size, for each specified finish and color of the following materials:
   1. For each type of architectural woodwork profile and paneling, minimum 8 inches square or 8 linear inches in length, illustrating proposed shapes, sizes, and finishes of panels, moldings, and other profiles
   2. For each solid wood or wood veneered product indicated to receive transparent finish, provide at least three samples illustrating standard range of wood grain, stain color, and sheen, for selected color.
   3. Plastic laminate.
   4. Solid surface.
   5. PVC edge banding.

E. Fabricator Qualifications: Include evidence of accreditation with quality control program.

F. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with experience on Projects of similar size and scope.
   1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
   2. Single Source Responsibility: Provide and install this work from single fabricator.
      a. It is acceptable to subcontract portions of the work to a separate specialty subcontractor (for example, pre-fabricated plastic-laminate-faced casework); however, each fabricator shall be independently accredited; submit accreditation for each fabricator. The primary woodwork contractor shall be responsible for ensuring the work of all Division 06 sections is well coordinated and properly fabricated and installed.

B. Quality Certification:
   1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org/#sle.
      a. This AWI (QCP) project is registered as project number _____.
   2. Provide for third-party AWI final inspection of fabricated architectural casework (prior to delivery). AWI program of self-certification in lieu of third-party inspection is not acceptable.
   3. Provide for third-party AWI final inspection of field-installed woodwork (after installation). AWI program of self-certification in lieu of third-party inspection is not acceptable.
   4. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) requirements for grade or grades specified.
   5. Provide designated labels on shop drawings as required by certification program.
   6. Provide designated labels on installed products as required by certification program.
   7. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
   8. Replace, repair, or rework all work for which certification is refused.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with Section 2 of the Architectural Woodwork Standards: "Care & Storage."

B. Deliver woodwork after finishes are complete, including painting, and HVAC is operating at occupancy conditions in all spaces where woodwork will be installed.

C. Store in an environmentally controlled location. Protect units from moisture damage.

1.07 FIELD CONDITIONS

A. During and after installation of woodwork, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.

B. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84, unless otherwise indicated for specific products.

C. All countertop surfaces shall be NSF approved for food contact.

D. Accessibility Requirements: Fabricate and install woodwork and casework in compliance with ICC/ANSI A117.1 and with ADA Standards for Accessible Design.

E. Low-Emitting Materials:

1. Composite Wood: Any composite wood materials installed inside the weatherproofing system shall meet either EPA (TSCA); Title VI for ultra-low-emitting formaldehyde or no added formaldehyde (ULEF / NAUF).
2. Paints and Coatings: Paints and coatings field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with CAL (CDPH SM) AND shall meet applicable VOC limits of CARB (SCM) or SCAQMD 1113.
3. Adhesives and Sealants: Adhesives and sealants field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with CAL (CDPH SM) AND shall meet the chemical content requirements of SCAQMD 1168.

2.02 CABINETS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.

B. Plastic-Laminate-Clad Cabinets: Custom grade, except as modified below. Solid wood and wood panel construction; each unit self-contained and not dependent on adjacent units or building structure for rigidity; in sizes necessary to avoid field cutting except for scribes and filler panels. Include adjustable levelers for base cabinets.

1. Style: Reveal overlay. Ease doors and drawer fronts slightly at edges.
2. Cabinet Nominal Dimensions: Unless otherwise indicated, provide cabinets of widths and heights indicated on drawings, and with following front-to-back dimensions:
   a. Base Cabinets: 24 inches.
   b. Tall Cabinets: 24 inches.
   c. Wall Cabinets: 12-1/2 inches. (Minimum clear interior depth shall be 11 inches)
3. Drawer Construction: Provide AWI premium grade for drawer box construction.

4. Base Construction: Provide adjustable levelers for all base cabinets to facilitate load transfer to the floor, isolate cabinet ends from the floor, and permit leveling.
    a. Provide one of the following two types of base construction:
        1) Separate Sub-Base: Cabinet sub-base shall be separate and continuous (no cabinet body sides-to-floor), exterior grade plywood with concealed fastening to cabinet bottom. Sub-base shall be ladder-type construction of individual front, back, and intermediates, to form a secure and level platform to which cabinets attach. Recess sub-base at exposed cabinet end panels 1/4 inch from face of finished end, for flush installation of finished base material by other trades.
        2) Integral Base: Provide end panels, cabinet bottoms, and horizontal toe kick members integrally joined together for structural strength. Adjustable levelers shall be provided at each corner for each cabinet.
    b. Toe Kick: Toe kick shall be nominal 4 inch height. Reduce as necessary via field modification due to construction tolerances and concrete slab levelness to maintain maximum height dimensions indicated.
5. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline.
    a. Finish: Matte or suede, gloss rating of 5 to 20.
    b. Surface Color and Pattern: As indicated on drawings.
    c. Exposed Interior and Semi-Exposed Surfaces: Provide HPDL, type VGS or CLS, at semi-exposed interiors of cabinets (cabinets with doors) and drawer boxes. Provide type VGS for exposed interior horizontal shelving surfaces and interiors of open cabinets (no doors).
    d. Apply undecorated laminate backing sheet to concealed reverse side of plastic laminate finished surfaces.
    e. Wood Grain Pattern: If wood grain is indicated or selected for plastic laminate color/pattern, provide sequence matched finish across each elevation. Grain shall run vertically across all doors, drawers, fronts, and false fronts; mismatched grain direction is not allowed.

C. ADA Sink Panels: Fabricate a panel of 3/4-inch moisture resistant core material and veneer/cladding material to match adjacent cabinets. Panel shall be removable for service access to undercounter plumbing. Provide with Z-clip attachment system for concealed fastening and with a steel cable retainer, minimum 3 feet long, so that panel can be set aside for service access. Fasten Z-clips and steel cable retainer to panel and to substrate with tamper-resistant fasteners.
    1. Provide an undercounter vertical "apron" piece at front of ADA sink locations as indicated, flush to fronts of adjacent cabinets and finished to match.

2.03 WOOD-BASED COMPONENTS

A. Low-Emitting Materials: Provide composite wood products that meet the requirements of EPA (TSCA); Title VI for formaldehyde emissions.

B. Core Material for Cabinets: ANSI A208.1, Grade M-2 particleboard.
    1. At Contractor's option, cabinet backs may be fabricated of ANSI A208.2, Grade MD fiberboard.

C. Core Material for Countertops: Manufacturer's standard ANSI A208.1, Grade M-2 particleboard, or ANSI A208.2, Grade MD fiberboard.
    1. At countertops containing sinks, provide core material meeting ANSI MR10 for moisture resistance. Available Products:

a. Arauco North America; Duraflake VESTA Moisture Resistant ULEF.
b. Collins Pine; FreeForm.
c. Georgia-Pacific; Ultrastock MR MDF.
d. Roseburg Forest Products; SkyBlend MR-10.

2.04 PANEL CORE MATERIALS

A. Particleboard: Composite panel composed of cellulosic particles, additives, and bonding system; comply with ANSI A208.1.

B. Medium Density Fiberboard (MDF): Composite panel composed of cellulosic fibers, additives, and bonding system; cured under heat and pressure; comply with ANSI A208.2.

2.05 THERMALLY FUSED LAMINATE PANELS

A. Thermally Fused Laminate (TFL): Melamine- or polyester-resin-saturated decorative papers; for fusion to composite wood substrates under heat and pressure.
   1. Test in accordance with NEMA LD 3 Section 3.
   2. Panel Core Substrate: Particleboard.
   3. Color: White.

2.06 LAMINATE MATERIALS

A. Manufacturers:
   1. Formica Corporation; High Pressure Laminate.
   2. Panolam Industries International, Inc; Nevamar Standard HPL.
   3. Panolam Industries International, Inc; Pionite Standard HPL.
   4. Wilsonart LLC; High Pressure Laminate (HPL).

B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.

C. Color and Pattern: As indicated on the drawings.

D. Provide specific types as follows:
   1. Horizontal Countertop Surfaces: HGS, 0.048 inch (1.2 mm) nominal thickness.
   2. Vertical Surfaces and Non-Countertop Horizontal Surfaces: VGS, 0.028 inch (0.7 mm) nominal thickness.
   3. Cabinet Liner: CLS, 0.020 inch (0.5 mm) nominal thickness.
   4. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.07 COUNTERTOPS

A. Fabricate in accordance with AWI/AWMAC/WI (AWS), Section 11 - Countertops, Custom Grade and with manufacturer's requirements.

B. Plastic Laminate Countertops: High-pressure decorative laminate (HPDL) sheet bonded to substrate.
   1. Laminate Sheet: NEMA LD 3, Grade HGS, 0.048 inch nominal thickness.
   2. Core: Particleboard or fiberboard as specified, except provide moisture resistant type at sink locations. Build up core material for total countertop thickness indicated.
   3. Exposed Edge Treatment: Square, substrate built up to 1-1/2 inch thick unless otherwise indicated; covered with 3 mm edge banding with eased ends.

4. Back and End Splashes: 3/4-inch thick core material with Grade HGS face and 0.5 mm edge banding/tape at edges.

2.08 ACCESSORIES & ACCESSORY MATERIALS

A. Adhesive: Type recommended by fabricator to suit application.

B. Plastic Edge Banding: Extruded PVC, flat shaped; smooth finish; of width to match component thickness.
   1. Provide 3 mm edge banding at all door and drawer front edges and laminate countertop edges.
   2. Provide 0.5 mm edge banding (tape) at cabinet body edges, shelf edges, and other semi-exposed/exposed interior edges.
   3. Color: To be selected by Architect from Manufacturer's full range.

C. 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.

D. Concealed Joint Fasteners: Threaded steel.

E. Grommets: Standard plastic grommets for countertop cut-outs, in black color unless otherwise indicated.
   1. Grommet Size: To fit 2-1/2 inch diameter cut-out, nominal, unless otherwise indicated.
   2. Grommets shall have removable caps and slot for wire passage.

2.09 HARDWARE

A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.

B. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated shelf rests, polished chrome finish, for nominal 1 inch spacing adjustments.

C. Workstation Brackets: Fixed, L-shaped, corner reinforced, face-of-stud mounting. Provide at all countertop/worksurface that is unsupported by cabinetry at 16 inches o.c., unless otherwise indicated.
   1. Materials: Formed steel shapes.
      a. Finish: Manufacturer's standard, factory-applied, textured powder coat.
      b. Color: To be selected by Architect from manufacturer's full range.
   2. Load Capacity: 1000 lbs minimum per pair of brackets, tested at 16 inches o.c. spacing.
   3. Size: Provide nominal sizes below. Provide additional sizes as required for other countertop/workstation applications indicated on Drawings.
      a. Provide 21 inches high by 28 inches deep for standard 30 inch deep countertops.
      b. Provide 21 inches high by 21 inches deep for standard 25 inch deep countertops.
   4. Products:
      a. A&M Hardware, Inc; Standard Brackets.
      b. Best Brackets; ADA Workstation Support Standard Steel Bracket.
      c. FastCap; SpeedBrace.
      d. Lyman Associates; Counter Top Supports.
      e. Substitutions: See Section 016000 - Product Requirements.

D. Vanity Brackets: Cantilevered support leg, face-of-stud mounting.

E. Drawer and Door Pulls: BHMA A156.9, B02011, back-mounted "U" shaped wire pull, steel with chrome finish, 4 inch centers.

F. Cabinet and Drawer Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish. Provide on all cabinet doors and drawers unless otherwise indicated.

G. Drawer Slides:
   1. Type: Full extension.
   2. Static Load Capacity: Heavy Duty grade.
      a. For standard box drawers under 30 inches wide, provide BHMA Grade 1HD-100 with minimum load capacity of 100 lbf.
      b. For file drawers and drawers 30 inches wide or larger, provide BHMA Grade 2HD-200 with minimum load capacity of 200 lbf.
      c. For pencil drawer slides, provide 3/4 extension with minimum load capacity of 45 lbf.
   3. Mounting: Side mounted.
   4. Stops: Integral type.
   5. Features: Provide soft close type.
   6. Manufacturers:
      a. Accuride International, Inc.
      b. Fulterer USA.
      c. Grass America Inc.
      d. Knape & Vogt Manufacturing Company.

H. Waste/Recycle Bin Slides: Heavy-duty, ball-bearing type slides that bottom mount to inside of cabinet, with integral wire system to hold bins in place. Provide specific model for cabinet width indicated.
   1. Static Load Capacity: Minimum 100 lbs.
   2. Features: Provide with integral stops and soft-close operation.
   3. Products:
      a. Fulterer USA; FR 3607/3608.
      b. Knape & Vogt; SBM/PSW Series.
      c. Hafele; Waste Bin Pull Out.

I. Hinges: Butt type, BHMA A156.9, Grade 1, 2-3/4 inch, 5-knuckle steel with nickel-plated finish. Provide with antifriction bearings and rounded hospital tips.
   1. Provide two hinges for doors less than 48 inches high, and three hinges for doors more than 48 inches high.

J. Hinges: European style concealed type, BHMA A156.9, B01602, steel with nickel-plated finish.
   1. Provide minimum 110 degree opening standard, and 160 degree opening at ADA sink base cabinets.

2.10 FABRICATION

A. Assembly: Shop assemble casework items for delivery to site in units easily handled and to permit passage through building openings.

B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
   1. Fittings and Fixture Locations: Cut and drill components for fittings and fixtures.

2. Scribes and Fillers: Panels of matching construction and finish, for locations where cabinets do not fit tight to adjacent construction.
3. Seal or prime paint concealed cut edges of wood and laminate casework.

D. Hardware Application: Factory-machine casework members for hardware that is not surface applied.

E. Apron Frames: Construction similar to other cabinets, with modifications.
1. Frames fabricated from panels standard with the manufacturer. Include front and back panels, with drawer suspension framing mechanically fastened to support channels spanning between them.

F. 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 exposed edges.

G. Countertop Fabrication: Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
1. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall, or as indicated.
2. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

H. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
1. Height: 4 inches, unless otherwise indicated.
2. Mechanically fasten back and end splashes to countertops with steel brackets at 16 inches on center.

I. Wall-Mounted Counters (not mounted over cabinets): Provide ADA compliant knee space with brackets, skirts, or aprons, as indicated on Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Site Verification of Environmental Conditions:
1. Do not deliver woodwork or casework until the following conditions have been met:
a. Building has been enclosed (windows and doors sealed and weather-tight).
b. An operational HVAC system that maintains temperature and humidity at occupancy levels has been put in place.
c. Ceiling, overhead ductwork, piping, and lighting have been installed.
d. Installation areas do not require further “wet work” construction.

B. For Base Cabinets Installation: Examine floor levelness and flatness of installation space. Do not proceed with installation if encountered floor conditions required more than 1/2 inch leveling adjustment. When installation conditions are acceptable, for each space, establish the high point of the floor. Set and make level and plumb first cabinet in relation to this high point, and provide field modifications as required to not exceed maximum height dimensions.
1. Construction tolerances shall not apply to casework maximum height dimensions; maximum indicated dimension shall be maintained at any point along the length of casework, regardless of floor levelness.
2. Field modifications shall be made to the toe kick to account for leveling due to floor levelness.

C. For Wall Cabinets Installation: Examine wall surfaces in installation space. Do not proceed with installation if the following conditions are encountered:
   1. Maximum variation from plane of masonry wall exceeds 1/4 inch in 10 ft and 1/2 inch in 20 ft or more, and/or maximum variation from plumb exceeds 1/4 inchper story.
   2. Maximum Variation of finished gypsum board surface from true flatness: 1/8 inch in 10 feet in any direction.

D. Verify adequacy of backing and support framing.

E. 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) requirements for grade(s) indicated and in accordance with manufacturer's instructions.

B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.

C. Use fixture attachments in concealed locations for wall mounted components.

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. Fasten together cabinets in continuous runs, with joints flush, uniform and tight. Misalignment of adjacent units not to exceed 1/16 inch. In addition, do not exceed the following tolerances:
   1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
   2. Variation of Bottoms of Wall Cabinets from Level: 1/8 inch in 10 feet.
   3. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet.
   4. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch.
   5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.

G. Secure wall cabinets at top and bottom, at each end and no more than 16 inches on center. Secure directly into metal wall framing, or into FRT wood or metal channel blocking with No. 10 wafer head screws. Wall mounted hanger strips are not acceptable.

H. Countertops: Install countertops intended and furnished for field installation in one true plane, with ends abutting at hairline joints, and no raised edges.

I. 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. Test installed work for rigidity and ability to support loads.

B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

3.05 PROTECTION

A. Do not permit finished casework to be exposed to continued construction activity.

B. Protect casework and countertops from ongoing construction activities. Prevent workmen from standing on, or storing tools and materials on casework or countertops.

C. Repair damage, including to finishes, that occurs prior to Date of Substantial Completion, using methods prescribed by manufacturer; replace units that cannot be repaired to like-new condition.

END OF SECTION 064100

SECTION 072100
THERMAL INSULATION

PART 1 GENERAL

1.01 REFERENCE STANDARDS

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

B. ASTM E1414/E1414M - Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum.

1.02 SUBMITTALS

A. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Protect foam-plastic insulation from physical damage, including chipping, cracking, or soiling. Do not use boards that are damaged due to delivery or handling.

B. Store insulation in a manner that protects from damage or deterioration, including moisture, soiling, or UV exposure.

1.04 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

B. Coordinate with insulation manufacturer for UV exposure requirements and coordinate the schedule of construction to ensure insulation is concealed in a timely manner.

PART 2 PRODUCTS

2.01 BLANKET INSULATION MATERIALS

A. Flexible Glass Fiber Blanket Thermal Insulation: Preformed insulation, complying with ASTM C665; friction fit.

1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
2. Smoke Developed Index: 50 or less, when tested in accordance with ASTM E84.
3. Facing: Unfaced.

2.02 MISCELLANEOUS GAP / CRACK FILLER

A. General: Fill miscellaneous joints and cracks with mineral wool batt insulation (specified above) or with closed-cell polyurethane foam at Contractor's option.

B. Closed Cell Polyurethane Foam:

1. Provide insulation that conforms to ULC S705.1, Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density - Material" or ASTM C 1029, Type II, and performance requirements listed.
2. Flame-spread index of 0 and maximum smoke development index of 5, when tested in accordance with ASTM E84.
3. Products:
   a. Dow; Enerfoam Professional Foam Sealant.

b. Dupont; Great Stuff Pro Gaps & Cracks.
c. Hilti; CF-AS Crack and Joint All Seasons.
d. Substitutions: See Section 016000 - Product Requirements.

2.03 ACCESSORIES

A. Tape joints of rigid insulation in accordance with insulation manufacturers' instructions.

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

C. Adhesive: Type recommended by insulation manufacturer for application.

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 BATT INSTALLATION

A. Install insulation in accordance with manufacturer's instructions.

B. Install in exterior wall and roof 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.

3.03 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION 072100

SECTION 079200
JOINT SEALANTS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.

B. ASTM C834 - Standard Specification for Latex Sealants.

C. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications.

D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.

E. ASTM C1193 - Standard Guide for Use of Joint Sealants.

F. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants.

G. ASTM C1311 - Standard Specification for Solvent Release Sealants.

H. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints.

I. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.

J. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board.

K. SCAQMD 1113 - Architectural Coatings.

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   4. Substrates the product should not be used on.

B. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.

C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

D. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

E. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.

F. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.

G. Executed warranty.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section, and is approved and/or certified by manufacturer.

B. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
   1. Adhesion Testing: In accordance with ASTM C794.
   2. Compatibility Testing: In accordance with ASTM C1087.
   3. Allow sufficient time for testing to avoid delaying the work.
   4. Deliver sufficient samples to manufacturer for testing.
   5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.

C. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.
   1. Identification of testing agency.
   2. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
      a. Test date.
      b. Copy of test method documents.
      c. Age of sealant upon date of testing.
      d. Test results, modeled after the sample form in the test method document.
      e. Indicate use of photographic record of test.

D. Field Adhesion Test Procedures:
   1. Allow sealants to fully cure as recommended by manufacturer before testing.
   2. Have a copy of the test method document available during tests.
   3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
   4. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
   5. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.
   6. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.

E. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
   1. Sample: At least 18 inches long.
   2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch by that percentage; if adhesion failure occurs before the 1-inch mark is that distance from the substrate, the test has failed.
   3. If either adhesive or cohesive failure occurs before minimum elongation, take necessary measures to correct conditions and retest; record each modification to products or installation procedures.

1.04 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide 5-year manufacturer warranty for installed sealants and accessories that fail to achieve a watertight seal, exhibit loss of adhesion or cohesion, or do not cure. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 JOINT SEALANT APPLICATIONS

A. Scope:
   1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to:
      a. Wall expansion and control joints.
      b. Joints between door, window, and other frames and adjacent construction.
      c. Joints between different exposed materials.
      d. Openings below ledge angles in masonry.
      e. Other joints indicated below.
   2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
      a. Joints between door, window, and other frames and adjacent construction.
      b. Wall and ceiling joints.
      c. Joints between plumbing fixtures and floor or wall construction.
      d. Other joints indicated below.
   3. Do not seal the following types of joints:
      a. Intentional weep holes in masonry.
      b. Joints indicated to be treated with manufactured expansion joint cover, or some other type of sealing device.
      c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
      d. Joints where installation of sealant is specified in another section.

B. Exterior Joints: Use non-sag non-staining silicone sealant (ES-1), unless otherwise indicated.
   1. Type ES-1 or ES-2 - Joints between walls and frames of doors, windows, and louvers.
   2. Type SRS-1 - Bedding joints.

C. Interior Joints: Use non-sag polyurethane sealant (ES-4), unless otherwise indicated.
   1. Type ES-3 - Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
   2. Type ES-5 - Floor Joints: Self-leveling polyurethane "traffic-grade" sealant.
   3. Type AS-1 - Joints at sound-rated or acoustic assemblies, and at full-height panel wall and partition assemblies indicated to have sound attenuation batts.
   4. Type LS-1 - Joints around perimeters of interior doors, windows, elevator entrances, and similar framed openings.

D. Interior Wet Areas: Bathrooms, restrooms, and kitchens; fixtures in wet areas include plumbing fixtures, countertops, cabinets, and other similar items.

2.02 JOINT SEALANTS - GENERAL

A. Low-Emitting Materials:
   1. Paints and Coatings: Paints and coatings field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with CAL (CDPH SM) AND shall meet applicable VOC limits of CARB (SCM) or SCAQMD 1113.
   2. Adhesives and Sealants: Adhesives and sealants field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with CAL (CDPH SM) AND shall meet the chemical content requirements of SCAQMD 1168.

2.03 NONSAG JOINT SEALANTS

A. Type ES-1 - Low-Modulus Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus and minus 50 percent, minimum.
   2. Nonstaining to Porous Stone: Nonstaining to light-colored natural stone when tested in accordance with ASTM C1248.
   3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
   4. Color: To be selected by Architect from manufacturer's full range.
   5. Products:
      a. Master Builders Solutions; MasterSeal NP 100.
      b. Momentive Performance Materials, Inc/GE Silicones; SCS 2000 SilPruf.
      c. Pecora Corporation; Pecora 890 NST (Non-Staining Technology) or 890 FST (Field Tint).
      d. Polymeric Systems, Inc.; PSI-641.
      e. Tremco Commercial Sealants & Waterproofing; Spectrem 3 or Spectrem 4-TS (Field Tint).
      f. Substitutions: See Section 016000 - Product Requirements.

B. Type ES-2 - Medium-Modulus Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus and minus 50 percent, minimum.
   2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
   3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
   4. Color: To be selected by Architect from manufacturer's full range.
   5. Manufacturers:
      a. Dow Chemical Company; DOWSIL 795 Silicone Building Sealant.
      b. Momentive Performance Materials, Inc/GE Silicones; SCS9000 SilPruf NB - Non-Staining Silicone Weatherproofing Sealant.
      c. Pecora Corporation; Pecora 895 NST (Non-Staining Technology).
      d. Tremco Commercial Sealants & Waterproofing; Spectrem 2.
      e. Substitutions: See Section 016000 - Product Requirements.

C. Type ES-3 - Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic. Neutral- or acid-curing per manufacturer standard.
   1. Color: White.
   2. Products:

a. Dow; DOWSIL 786 Mildew Resistant.
b. Pecora Corporation; Pecora 898 NST (Non-Staining Technology).
c. Tremco Commercial Sealants & Waterproofing; Tremsil 600 or Tremsil 200.
d. Substitutions: See Section 016000 - Product Requirements.

D. Type ES-4 - Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; multi-component; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 25 percent, minimum.
2. Color: To be selected by Architect from manufacturer's full range.
3. Products:
a. ITW Polymers Sealants; Permathane SM 7200.
b. Master Builders Solutions by BASF; MasterSeal NP2.
c. Pecora Corporation; DynaTrol II.
d. Sika Corporation; Sikaflex-2c NS.
e. Tremco Commercial Sealants & Waterproofing; Dymeric 240 FC or Vulkem 227.
f. Substitutions: See Section 016000 - Product Requirements.

E. Type LS-1 - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
1. Color: To be selected by Architect from manufacturer's full range.
2. Grade: ASTM C834; Grade NF.
3. Products:
a. Bostik, Inc; Chem-Calk 600.
b. ITW Polymers Sealants; SM 8200.
c. Master Builders Solutions; MasterSeal NP 520.
d. Pecora Corporation; AC-20 +Silicone.
e. Tremco Commercial Sealants & Waterproofing; Tremflex 834.
f. Substitutions: See Section 016000 - Product Requirements.

F. Type AS-1 - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging acoustical sealant.
1. Color: Standard colors matching finished surfaces, Type OP (opaque).
2. Grade: ASTM C834; Grade NF.
3. Manufacturers:
a. Accumetric LLC; BOSS 826 Acoustical Sound Sealant.
b. Franklin International, Inc; Titebond GREENchoice Acoustical Smoke & Sound Sealant.
c. Hilti, Inc; CP 506 Smoke and Acoustical Sealant.
d. Master Builders Solutions; MasterSeal NP 520.
e. Momentive Performance Materials, Inc/GE Silicones; RCS20 Acoustical.
f. Pecora Corporation; AC-20 FTR or AIS-919.
g. Specified Technologies Inc; Smoke N' Sound Acoustical Sealant.
h. Tremco Commercial Sealants & Waterproofing; Tremstop Smoke and Sound.
i. Substitutions: See Section 016000 - Product Requirements.

G. Type SRS-1 - Butyl Sealant: Solvent-based; ASTM C1311; single component, nonsag; not expected to withstand continuous water immersion or traffic.
1. Products:

a. Bostik, Inc; Chem-Calk 300.
b. Pecora Corporation; Pecora BC-158 Butyl Rubber Sealant.
c. Tremco Inc.; Tremco Butyl Sealant.
d. Substitutions: See Section 016000 - Product Requirements.

2.04 SELF-LEVELING JOINT SEALANTS

A. Type ES-5 - Self-Leveling Polyurethane Sealant for Traffic: Polyurethane; ASTM C920, Grade P, Uses T, M and A; single or multi-component; explicitly approved by manufacturer for traffic exposure.
   1. Movement Capability: Plus and minus 25 percent, minimum.
   2. Products:
      a. Bostik, Inc.; Chem-Calk 550.
      b. Pacific Polymers, Inc; Elast-Thane 227 Type 1 (Self-Leveling).
      c. Pecora Corporation; Dynatrol II-SL.
      d. Polymeric Systems, Inc; PSI-270SL.
      e. Tremco Commercial Sealants & Waterproofing; Vulkem 45SSL or 445SSL.
      f. W. R. MEADOWS, Inc; POURTHANE SL.
      g. Substitutions: See Section 016000 - Product Requirements.

2.05 ACCESSORIES

A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.

B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

C. Masking Tape: Self-adhesive, nonabsorbent, nonstaining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

D. Joint Cleaner: Noncorrosive and nonstaining type, type recommended by sealant manufacturer; compatible with joint forming materials.

E. Primers: Type recommended by sealant manufacturer to suit application; nonstaining.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

D. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.
   1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.
   2. Notify Architect of date and time that tests will be performed, at least seven days in advance.
   3. Record each test on Preinstallation Adhesion Test Log as indicated.
   4. If any sample fails, review products and installation procedures, consult manufacturer, or take other measures that are necessary to ensure adhesion; retest in a different location;

if unable to obtain satisfactory adhesion, report to Architect.

5. After completion of tests, remove remaining sample material and prepare joints for new sealant installation.

3.02 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in an inconspicuous area to verify that it does not stain or discolor slab.

3.03 INSTALLATION

A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Provide joint sealant installations complying with ASTM C1193.

C. Install 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 backing tape where backer rod cannot be used.

F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

I. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

J. Installation of Security Sealants: Install in locations indicated in accordance with manufacturer's written recommendations.

1. Apply pick-resistant non-flexible 95 shore “A” hardness epoxy type security sealant in all spaces and cracks between similar and dissimilar materials including, but not limited to, metal frames, windows, all fixtures except vitreous china plumbing fixtures, detention furniture, embeds, secure air diffusers, lock columns and receivers.
2. Apply tamper resistant flexible 55 shore “A” hardness security sealant in any open joints located in cells, including joints at the intersections of walls to walls, walls to ceilings and walls to floors.

3.04 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.

C. Destructive Adhesion Testing: If there are any failures in first 1,000 linear feet, notify Architect immediately.

D. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

E. Repair destructive test location damage immediately after evaluation and recording of results.

END OF SECTION 079200

SECTION 081113
STEEL DOORS AND FRAMES

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100).

B. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.

C. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames.

1.02 SUBMITTALS

A. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.

B. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

C. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

1.03 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.
   2. Curries, an Assa Abloy Group company.
   3. Fleming Door Products, an Assa Abloy Group company.
   4. Krieger Specialty Products.
   5. Mesker, dormakaba Group.
   6. Metal Products, Inc. (MPI)
   7. Pioneer Industries, Inc.; an Assa Abloy Group company.
   8. Republic Doors, an Allegion brand.
   9. Steelcraft, an Allegion brand.
   10. Technical Glass Products.

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. Door Top and Bottom Closures: Flush end closure channel, with top and door faces aligned.
    a. Inverted channel closure is acceptable for bottom edges and top edges of interior doors that are not exposed to view from above.
4. Door Edge Profile: Beveled edge.
5. Typical Door Face Sheets: Flush.
6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturer's standard.
7. 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.
8. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
    a. Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.

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 FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Frame Finish: Factory primed and field finished.

C. Interior Door Frames, Non-Fire Rated: Face welded type.
    1. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.

D. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.

2.04 FINISHES

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

2.05 ACCESSORIES

A. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.

B. 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.

C. 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.
   1. Install in accordance with ANSI/SDI A250.11.
   2. Do not remove temporary frame spreaders until after frames have been properly set and secured.

B. Coordinate frame anchor placement with wall construction.

C. Install door hardware as specified in Section 087100.

D. Comply with glazing installation requirements of Section 088000.

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

F. 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.
   1. Comply with clearances indicated in NFPA 80 for fire-rated doors.

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.

END OF SECTION 081113

SECTION 081416
FLUSH WOOD DOORS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.

B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition.

1.02 SUBMITTALS

A. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.

B. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.

C. Selection Samples: Submit manufacturer's color charts indicating full range of available colors, for each product requiring color selection.

D. Verification Samples: Submit three physical samples of door veneer, approximately 8 by 8 inches in size illustrating standard range of wood grain, stain color, and sheen.

E. Warranty, executed in Owner's name.

1.03 QUALITY ASSURANCE

A. Source Limitations: Provide all flush wood doors from a single manufacturer.

1.04 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.

1.05 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Wood Veneer Faced Doors:
   1. Eggers Industries.
   2. Lambton Doors.
   3. Masonite Architectural; Aspiro Select Wood Veneer Doors.
   4. Oshkosh Door.
   5. VT Industries, Inc.

2.02 DOORS

A. Doors: See drawings for locations and additional requirements.

1. Doors shall be manufactured by the hot-press method, bonding faces, crossbands, and core together in a single operation with Type I glue. Doors manufactured by cold-pressing 2- or 3-ply pre-manufactured door skins to multiple cores in the same press will not be accepted.

B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
   1. Provide solid core doors at each location.

2.03 DOOR AND PANEL CORES

A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), particleboard Grade LD-2 per ANSI A 208.1; plies and faces as indicated.
   1. Provide structural-composite-lumber (SCLC) core for doors with glazing area cut out for 9-inch stile width doors.
   2. Provide structural-composite-lumber (SCLC) core for doors with exit devices.

2.04 DOOR FACINGS

A. Veneer Facing for Transparent Finish: Veneer wood species, finish, and veneer grain (cut) to match existing doors to remain,, veneer grade in accordance with quality standard indicated.
   1. Vertical Edges: Any option allowed by quality standard for grade.
   2. "Pair Match" each pair of doors; "Set Match" pairs of doors within 10 feet of each other when doors are closed.

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.

C. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.

D. For doors indicated to be factory-finished, factory install glazing in doors in compliance with quality standards specified, using manufacturer's standard elastomeric glazing sealant.

E. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

F. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

G. 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), Section 5 - Finishing for grade specified and as follows:
   1. Transparent:
      a. System - 5, Varnish, Conversion or System 11, catalyzed polyurethane.
      b. Sheen: Satin.

B. Factory finish doors in accordance with approved sample.

C. Seal door top edge with color sealer to match door facing where doors will be exposed to view from above.

2.07 ACCESSORIES

A. Glazed Openings:
   1. Heat-Strengthened and Fully Tempered Glass: ASTM C1048.
   2. Glazing: Single vision units, 1/4 inch thick glass.
   3. Tint: Clear.

B. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws. At fire-rated doors, provide noncombustible wood stops with concealed metal clips for indicated fire rating.

C. Door Hardware: Refer to Section 087100.

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.
   1. Install fire-rated doors in accordance with NFPA 80 requirements.

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.

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.

3.04 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

END OF SECTION 081416

SECTION 084313
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site.

B. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.

C. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).

D. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).

1.02 SUBMITTALS

A. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.

B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.

1. Include design engineer's stamp or seal on shop drawings for attachments and anchors.

C. Selection Samples: Submit manufacturer's color charts representing manufacturer's full range of available colors, for each type of product required.

D. Verification Samples: Submit physical samples in manufacturer's standard size indicating actual panel material and selected colors, for each type of product required.

E. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.

F. Designer's qualification statement.

G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.03 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.

1.04 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.

1.05 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Material/Labor Warranty: Provide a 2-year material and workmanship warranty, covering failures including but not limited to, structural and performance failures, excessive material deterioration, failure of operating components, and water or air infiltration. Complete forms in Owner's name and register with warrantor.

C. Finish Warranty: Provide 10-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Aluminum-Framed Storefront - Interior - Non-Thermal - Center Set - 2" x 4.5":
   1. EFCO Corp; 402.
   2. Kawneer North America; Trifab VG 451.
   3. Oldcastle Building Envelope; FG 3000.
   4. Tubelite, Inc; E14000 Non-Thermal.
   5. YKK AP America, Inc; YES 45 FI.

2.02 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 Position: Centered (front to back).
   2. 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.
   3. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
   4. 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.
   5. 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.
   6. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
   7. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

B. Performance Requirements:
   1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, 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 and as indicated on Structural drawings.

b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.

2. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 10 psf.
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: 56, minimum, measured in accordance with AAMA 1503.

2.03 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, drainage holes and internal weep drainage system.
   1. Glazing Stops: Flush.

B. Glazing: Refer to Section 088000.

2.04 MATERIALS AND ACCESSORIES

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Fasteners: Stainless steel.

C. Metal Extrusions and Accessories:
   1. Metal Trim, Filler, and Closures (Brake Metal): Form interior filler panels for closing ends of partition systems, concealing adjacent structural elements, and for other applications as indicated on Drawings. Form from minimum 0.050-inch aluminum sheet coil, producing a panel of same thickness as partitions or mullions unless otherwise indicated. Incorporate reveals, trim, and concealed anchorages for attaching to adjacent surfaces. Finish trim to match storefront unless otherwise indicated.
   2. Offset Anchorage System: Provide frame anchorage incorporating L-shaped offset anchors or strap anchor component, and finished extruded interlocking L-shaped cover trim matching storefront framing. Anchorage "clip and cover" system shall be engineered by storefront manufacturer.
   3. Enhanced (High Performance) Sill Flashing: Provide thermally-broken extruded aluminum sill flashing with 2-inch tall back leg and bottom profile with outboard trough and weep holes to direct water to exterior. Provide full-frame-depth end dams mechanically attached to sill flashing extrusion and sealed with silicone. Provide silicone sill flashing splice sleeves and sealant as required at end dams and penetrations for anchorage. Provide finish to match framing.

D. Sealant for Setting Thresholds: Non-curing butyl type.

E. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

2.05 FINISHES

A. Superior Performing Organic Coatings System: Manufacturer's standard multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent polyvinylidene fluoride (PVDF) resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch.

B. Color: To be selected by Architect from manufacturer's full range.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that storefront wall openings and adjoining water-resistive and/or air barrier 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. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

F. Install glass and infill panels using glazing method required to achieve performance criteria; see Section 088000.

G. 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. Provide services of storefront manufacturer's field representative to observe for proper installation of system and submit report.

3.05 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.

3.06 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 084313

SECTION 087100
DOOR HARDWARE

PART 1 GENERAL

1.01 REFERENCE STANDARDS

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

B. BHMA (CPD) - Certified Products Directory.

C. BHMA A156.1 - Standard for Butts and Hinges.

D. BHMA A156.3 - Exit Devices.

E. BHMA A156.4 - Door Closers and Pivots.

F. BHMA A156.7 - Template Hinge Dimensions.

G. BHMA A156.16 - Standard for Auxiliary Hardware.

H. DHI (H&S) - Sequence and Format for the Hardware Schedule.

I. ICC A117.1 - Accessible and Usable Buildings and Facilities.

J. ITS (DIR) - Directory of Listed Products.

K. NFPA 70 - National Electrical Code.

L. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.

M. NFPA 101 - Life Safety Code.

N. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.

O. UL (DIR) - Online Certifications Directory.

P. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.

B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

C. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; attendance is required by affected installers and the following:
   1. Architect.
   2. Installer's Architectural Hardware Consultant (AHC).
   3. Hardware Installer.
   4. Owner's Security Consultant.

D. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.

E. Keying Requirements Meeting:
   1. Attendance Required:
      a. Contractor.
      b. Owner.
      c. Architect.
      d. Installer's Architectural Hardware Consultant (AHC).

2. Agenda:
   a. Establish keying requirements. Confirm Owner's facility standards.
   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 digital PDF copies within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.
5. Deliver established keying requirements to manufacturers.

1.03 SUBMITTALS

A. 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.

B. 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.
   3. List groups and suffixes in proper sequence.
   4. Provide complete description for each door listed.
   5. Provide manufacturer name, product names, and catalog numbers; include functions, types, styles, sizes and finishes of each item.
   6. Where electrified hardware is indicated, submit diagrams for power, signal, and control wiring that include details of interface with building safety and security systems. Include an operations narrative describing how opening operates from either side at any given time.

C. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

D. Keying Schedule:
   1. Submit Keying Schedule in digital format, in compliance with requirements established during Keying Requirements Meeting, unless otherwise indicated.

E. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - 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.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified for commercial/institutional door hardware, with experience in work of similar size and scope.

B. Supplier Qualifications: Company with Door and Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) to assist in work of this section, and with experience in commercial/institutional work of similar size and scope.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

1.06 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer's Warranty: Provide warranty against defects in material and workmanship for period indicated. Complete forms in Owner's name and register with manufacturer.

1. Closers: Ten years, minimum.
2. Other Hardware: Two years, minimum.

PART 2 PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

A. Scheduled Door Hardware: Provide door hardware in compliance with this section and with the door hardware sets in the Door Hardware Schedule located at the end of this specification section.

B. Designations: Requirements for the design, function, grade, finish, size, and other characteristics for each item of door hardware are included in the Door Hardware Schedule located at the end of this specification section.

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type in the Door Hardware Schedule, for the purpose of establishing minimum requirements for that piece of hardware. Products that are equivalent in function, quality, size, finish, and other indicated criteria may be submitted, subject to approval by Architect.

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. Applicable provisions of NFPA 101.
4. Fire-Rated Doors: NFPA 80, listed and labeled by qualified testing agency for fire protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
5. Hardware on Fire-Rated Doors: Listed and classified by UL (DIR), ITS (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for application indicated.
6. Listed and certified compliant with specified standards by BHMA (CPD).
7. 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. See Division 28 for additional access control system requirements.

E. Lock Function: Provide lock and latch function numbers and descriptions of manufacturer's series. See Door Hardware Schedule.

F. 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.

2.03 HINGES

A. Manufacturers:
   1. McKinney; an Assa Abloy Group company.
   2. Hager Companies.
   3. Ives, an Allegion brand.
   4. Stanley, dormakaba Group.
   5. Substitutions: See Section 016000 - Product Requirements.

B. Hinges: Comply with BHMA A156.1, Grade 1.
   1. Butt Hinges: Comply with BHMA A156.1 and BHMA A156.7 for templated hinges.
      a. Provide hinge width required to clear surrounding trim.
   2. Provide hinges on every swinging door.
   3. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
   4. Provide following quantity of butt hinges for each door:
      a. Doors up to 60 inches High: Two hinges.
      b. Doors From 60 inches High up to 90 inches High: Three hinges.
      c. Doors 90 inches High up to 120 inches High: Four hinges.

2.04 EXIT DEVICES

A. Manufacturers:
   1. Corbin Russwin, Sargent, or Yale; an Assa Abloy Group company.
   2. DORMA USA, Inc.
   3. Stanley, dormakaba Group.
   4. Von Duprin, an Allegion brand.
   5. Substitutions: See Section 016000 - 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.
   3. Provide exit devices properly sized for door width and height.
   4. Provide strike as recommended by manufacturer for application indicated.
   5. Provide UL (DIR) listed exit device assemblies for fire-rated doors and panic device assemblies for non-fire-rated doors.

2.05 LOCK CYLINDERS

A. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.
   1. Provide cylinders from same manufacturer as locking device.
   2. Provide cams and/or tailpieces as required for locking devices.

2.06 CLOSERS

A. Manufacturers; Surface Mounted:
   1. Corbin Russwin or Sargent; an Assa Abloy Group company.
   2. DORMA USA, Inc; .
   3. LCN, an Allegion brand.
   4. Stanley, dormakaba Group.
   5. Substitutions: See Section 016000 - Product Requirements.

B. Closers: Comply with BHMA A156.4, Grade 1.
   1. Type: Surface mounted to door.
   2. Provide door closer on each exterior door.
   3. Provide door closer on each fire-rated and smoke-rated door.
   4. Where an overlapping astragal is included on pairs of swinging doors, provide coordinator to ensure door leaves close in proper order.

2.07 KICK PLATES

A. Manufacturers:
   1. Rockwood; an Assa Abloy Group company.
   2. Ives, an Allegion brand.
   3. Trimco.

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: 8 inch high by 2 inch less door width (LDW) on push side of door.

2.08 WALL STOPS

A. Manufacturers:
   1. Rockwood; an Assa Abloy Group company.
   2. Hager Companies.
   3. Trimco.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Wall Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
   1. Type: Bumper, concave, wall stop.
   2. Material: Aluminum housing with rubber insert.

2.09 SILENCERS

A. Manufacturers:
   1. Ives, an Allegion brand; ____: www.allegion.com/us/#sle.
   2. Rockwood; an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.

B. Silencers: Provide at equal locations on door frame 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.

2.10 FINISHES

A. Finishes: Provide door hardware of same finish, unless otherwise indicated. Refer to Door Hardware Schedule at the end of this section.

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. Preparation: Comply with DHI/ANSI A115 standards for preparation of steel doors and frames and for wood doors.
   1. Comply with SDI 107 for surface applied hardware on steel doors.

B. Install hardware in accordance with manufacturer's instructions and applicable codes.

C. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.

D. Use templates provided by hardware item manufacturer.

E. Do not install surface mounted items until application of finishes to substrate are fully completed.

F. 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. Mounting heights in compliance with ADA Standards:
      a. Locksets: 40-5/16 inch.
      b. Push Plates/Pull Bars: 42 inch.
      c. Deadlocks (Deadbolts): 48 inch.
      d. Exit Devices: 40-5/16 inch.

G. 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.

3.03 FIELD QUALITY CONTROL

A. Installer's Architectural Hardware Consultant (AHC) shall 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. Initial Adjustment: Provide initial adjustments on each door hardware item immediately prior to Substantial Completion. Verify that operable components function smoothly and properly.

1. Adjust hinges, closers, automatic door openers, and other operable items to ensure that sweep period and opening force requirements of swing doors comply with ADA standards and with requirements of authority having jurisdiction.
2. Remove and replace hardware that can not be adjusted to function smoothly and properly.

B. Post-Occupancy Adjustment: Installer's Architectural Hardware Consultant (AHC) shall return approximately six months after Substantial Completion and inspect each door hardware item and provide adjustments as necessary. Remove and replace hardware components that have failed due to defective or deteriorated materials, or due to faulty workmanship or installation.
   1. At the Post-Occupancy Adjustment, meet with Owner's designated representative(s) to review recommended maintenance and adjustment procedures. Provide training in the use of special maintenance tools.

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 017000 - Execution and Closeout Requirements.

B. Do not permit adjacent work to damage hardware or finish.

3.07 DOOR HARDWARE SCHEDULE

A. Refer to Door Hardware Schedule appended to the end of this section.

END OF SECTION 087100

HARDWARE SETS:

Hardware Group No. HW-1

For use on Door #(s):
202

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	OFFICE LOCK	ML2051 NSA		626	C-R
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HW-2

For use on Door #(s):
221

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	ML2057 NSA		626	C-R
1	EA	SURFACE CLOSER	4011		689	LCN
1	EA	ARMOR PLATE	8400 34" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

SECTION 088000
GLAZING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

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

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.

C. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.

D. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.

E. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass.

F. GANA (GM) - GANA Glazing Manual.

1.02 SUBMITTALS

A. Product Data on Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

B. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

C. Certificate: Certify that products of this section meet or exceed specified requirements.

1.03 QUALITY ASSURANCE

A. Perform Work in accordance with GANA (GM) and IGMA TM-3000 for glazing installation methods.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's instructions. Deliver and store in a manner to prevent exposure to weather/moisture, direct sun/UV, and temperature changes.

1.05 FIELD CONDITIONS

A. Ambient Conditions: Do not install glazing, gasketing, or liquid sealants under adverse weather conditions, or when temperatures are above or below manufacturer's recommended limitations for sealant installation.

1. Do not install glazing when ambient temperature is less than 40 degrees F.
2. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.06 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Float Glass Manufacturers:

1. Cardinal Glass Industries.
2. Guardian Glass, LLC.
3. Viracon.
4. Vitro Architectural Glass (formerly PPG Glass).

2.02 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.
   1. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
   2. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
   3. Provide Type I, Quality-Q3, Class 1 (clear) glazing unless otherwise indicated.
   4. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
   5. Low-Iron (Ultraclear) Glass: ASTM C1048, Type I, Class I, Quality - Q3.
      a. Products:
         1) Cardinal; Purevision.
         2) Guardian; UltraClear.
         3) Pilkington; Optiwhite.
         4) Vitro; Starphire.

B. Laminated Glass: Float glass laminated in accordance with ASTM C1172. Laminated glass shall be free of foreign substances and air or glass pockets.
   1. Laminated Safety Glass: Complies with ANSI Z97.1 - Class A or 16 CFR 1201 - Category II impact test requirements.
   2. Ionoplast Interlayer: 0.060 inch thick, minimum.
      a. Provide Kuraray "SentryGlas" or comparable ionoplast interlayer submitted as a properly formatted substitution request.
      b. Color: Clear.
      c. Interlayer Physical Properties:
         1) Young's Modulus:43 kpsi, when tested in accordance with ASTM D5026.
         2) Tensile Strength: 5.0 kpsi, when tested in accordance with ASTM D638.
         3) Elongation: 400%, when tested in accordance with ASTM D638.
         4) Flex Modulus: 50 kpsi, when tested in accordance with ASTM D790.
         5) Heat Deflection Temperature at 0.46 MPa: 110 degrees F, when tested in accordance with ASTM D648.

2.03 ACCESSORIES

A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option I. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.

B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option I. Continuous by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.

C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.

D. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

3.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

B. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

C. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

D. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

E. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

3.04 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.

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 fixed stop with sufficient pressure on gasket to attain full contact.

D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.05 FIELD QUALITY CONTROL

A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.

B. Monitor and report installation procedures and unacceptable conditions.

3.06 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

B. Remove nonpermanent labels immediately after glazing installation is complete.

C. Clean glass and adjacent surfaces after sealants are fully cured.

D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

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.

B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

3.08 GLAZING SCHEDULE

A. Type G1 - Monolithic Interior Vision Glazing:
   1. Applications: Interior glazing unless otherwise indicated.
   2. Glass Type: Fully tempered float glass. Provide with safety glazing labeling.
   3. Tint: Clear.
   4. Thickness: 1/4 inch, nominal.
   5. Glazing Method: Dry glazing method, gasket glazing.

END OF SECTION 088000

SECTION 092216
COLD FORMED STEEL FRAMING - NON-STRUCTURAL (CFSF-NS)

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Refer to Section 054000 - Cold-Formed Steel Framing - Structural (CFSF-S): Requirements for structural, load-bearing, metal stud framing and overhead/suspended/bulkhead framing.

1.02 REFERENCE STANDARDS

A. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

D. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members.

E. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

F. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.

G. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board.

1.03 SUBMITTALS

A. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.

PART 2 PRODUCTS

2.01 FRAMING MATERIALS

A. Non-Loadbearing Framing System Components: AISI S220; sheet steel, of size and properties necessary for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.

1. Steel Thickness (Studs and Runners): Minimum 0.0179-inch (18 mil / 25 gauge) unless otherwise required to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf, and as indicated below:
    a. Provide minimum 0.0329-inch thickness (33 mil / 20 gauge) for all partitions using 3-5/8-inch-deep studs where stud partition height is greater than 12 feet above floor level.
    b. Provide minimum 0.0329-inch (33 mil / 20 gauge - Structural) for high-density board applications, such as ASTM C1178 tile backing panels and ASTM C1629 abuse- or impact-resistant gypsum board, and at door frames.
    c. Provide minimum 0.0329-inch (33 mil / 20 gauge - Structural) for walls receiving heavy wall-hung items or loads, including but not limited to wall cabinets, wall-hung countertops, TV brackets, liquid tanks, folding and fixed seats, grab bars, handrails, exercise equipment, and shelving greater than 9 inches deep and over 3 feet in length.
2. Studs: C-shaped with flat faces.
3. Runners: U-shaped, sized to match studs.

4. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
5. Resilient Furring Channels: Single or double leg configuration; 1/2 inch channel depth.

B. Non-Loadbearing Framing Accessories:
1. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.
a. Materials: ASTM A36/A36M formed sheet steel support member with factory-welded ASTM A1003/A1003M steel plate base.
2. Bracing and Bridging: ASTM A653/A653M G90 galvanized steel; cold-rolled channel / hat-section profile; for lateral bracing of wall studs with slots for engaging on-module studs.
3. Framing Connectors: ASTM A653/A653M steel clips; secures cold rolled channel to wall studs for lateral bracing.
4. Sheet Metal Backing: 0.036 inch thick flat strap/plate.
5. Fasteners: Self-tapping screws designed for attachment of metal framing and recommended by manufacturer.
6. Anchorage Devices: Powder actuated or screw anchors with sleeves, recommended by manufacturer for anchorage to indicated substrates.
7. Acoustic Insulation: ASTM C665; preformed mineral-fiber, friction fit type, unfaced. Thickness as indicated, or sized to fit stud depth indicated.
8. Acoustic Sealant: Refer to Division 07 Section "Joint Sealants."

C. Isolation Strips: Provide either closed-cell foam tape with rubberized adhesive membrane or asphalt-saturated organic felt (ASTM D226, Type I, No. 15).

2.02 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. Install in accordance with ASTM C754. Provide framing, including bracing, bridging, and anchorage accessories, to meet L/240 deflection limit at a lateral pressure of 5 psf unless indicated otherwise.
1. Gypsum Board: At gypsum board partitions and assemblies, comply with applicable requirements of ASTM C840 for framing installation.
2. Install a continuous isolation strip where studs or stud-framed partitions directly abut dissimilar metals or exterior masonry wall.

B. Extend partition framing to ceiling in all locations.

C. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.

D. Align and secure top and bottom runners at maximum 24 inches on center.

E. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.

F. Install studs vertically at 16 inches on center, unless otherwise indicated.

G. Align stud web openings horizontally.

H. Secure studs to tracks using crimping method. Do not weld.

I. Fabricate corners using a minimum of three studs.

J. Install double studs at wall openings, door and window jambs, not more than 2 inches from each side of openings.

K. Install bracing, bridging, and anchorage to brace stud framing system rigid.

L. Coordinate erection of studs with requirements of door frames; install supports and attachments.

M. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.

N. Blocking: Use FRT wood blocking or metal channel stud blocking, secured to studs. Provide blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware, opening frames, and other built-in-place wall mounted items and equipment.

O. Furring: Install at spacing and locations shown on drawings. Lap splices a minimum of 6 inches.

3.03 CEILING AND SOFFIT FRAMING

A. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.

B. Install furring independent of walls, columns, and above-ceiling work.

C. Securely anchor hangers to structural members or embed them in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.

D. Space main carrying channels at maximum 72 inches on center, and not more than 6 inches from wall surfaces. Lap splice securely.

E. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.

F. Place furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.

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.

END OF SECTION 092216

SECTION 092900
GYPSUM BOARD

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units.

B. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units.

C. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

D. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.

E. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

F. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board.

G. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.

H. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units.

I. ASTM C1396/C1396M - Standard Specification for Gypsum Board.

J. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.

K. GA-216 - Application and Finishing of Gypsum Panel Products.

1.02 SUBMITTALS

A. Product Data:

1. Provide data on gypsum board, accessories, and joint finishing system.

1.03 DELIVERY, STORAGE, HANDLING, AND FIELD CONDITIONS

A. Do not deliver or install until building is weather-tight and conditioned.

B. Store materials in dry and clean location until needed for installation. During installation, handle in a manner that will prevent damage and to prevent marring and soiling of finished surfaces.

C. Do not install gypsum products that have gotten wet or moldy, or show signs of past moisture damage.

D. Maintain uniform temperature and humidity at occupancy conditions during and after installation. Allow products to acclimatize prior to installation.

PART 2 PRODUCTS

2.01 BOARD MATERIALS

A. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; with tapered edges.

1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.

a. Mold-resistant board is required whenever gypsum board is indicated in rooms subject to steam or water, including mechanical rooms, toilet rooms, custodial rooms, and kitchens.

3. Thickness:
   a. Vertical Surfaces: 5/8 inch.
   b. Ceilings: 5/8 inch.
   c. Curved Surfaces: Provide flexible 1/4 inch thickness gypsum board, installed in two layers.

B. Tile Backing Board:
   1. Application: Surfaces behind tile in wet areas including tub and shower surrounds.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. ANSI Cement-Based Board: Non-gypsum-based; cementitious panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 and ASTM C 1288 or ASTM C1325.
      a. Thickness: 5/8 inch.
      b. Available Products:
         1) FinPan, Inc.; Util-A-Crete Backer Board.
         2) National Gypsum Company; PermaBase Cement Board.
         3) USG Corporation; Durock Cement Board.
         4) Substitutions: See Section 016000 - Product Requirements.

C. 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 BOARD ACCESSORIES

A. Sound Attenuation Batts: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness sized to fit metal stud cavity.

B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant. Refer to sealant AS-1 in Division 07 Section "Joint Sealants."

C. Putty Pads: Non-hardening endothermic material, in pad form, faced on both sides with poly liner, designed to seal around penetrations and wiring devices, enhancing acoustic performance.
   1. Nominal Size: 7-1/4 x 7-1/4 x 3/16 inches.
   2. Available Products:
      a. 3M; Fire Barrier Moldable Putty Pads MPP+.
      b. Hilti; Firestop Putty Pad, CFS-P PA.
      c. Specified Technologies, Inc.; SpecSeal Putty Pad.

D. Beads, Joint Accessories, and Other Trim: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
   1. Corner Beads: Low profile, for 90 degree outside corners.
   2. L-Bead, LC-Bead, and U-Bead: Sized to fit gypsum wallboard size(s) indicated.

a. Provide LC-bead at exposed panel edges and U-bead at concealed panel edges, unless otherwise indicated. Provide L-bead at locations indicated.

E. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.

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. Sound Attenuation Batts: 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.

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. Install gypsum board with an open horizontal joint (gap) not to exceed 5/8-inch above finished floor slab, and tape and finish vertical joints to bottom edge of board to afford a smooth substrate for applied wall base.

D. Cementitious Backing Board: Install over steel framing members where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.

3.04 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints in compliance with ASTM C 840, consistent with lines of building spaces, and as indicated.
   1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
   2. At exterior soffits, not more than 30 feet apart in both directions.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Putty Pads: Install putty pads on the backside of items penetrating gypsum board on STC-rated walls/partitions. Items include, but are not limited to, wiring devices, cable, conduit, and pipe. Completely cover and seal around each penetration.

3.05 JOINT TREATMENT

A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
   2. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
   3. 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. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.06 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION 092900

SECTION 093000
TILING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar.

B. ANSI A108.1b - Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar.

C. ANSI A108.1c - Contractor's 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 Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar.

D. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship.

E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesive or Water Cleanable Tile-Setting Epoxy Adhesive.

F. ANSI A108.5 - Setting of Ceramic Tile with Dry-Set Cement Mortar, Modified Dry-Set Cement Mortar, EGP (Exterior Glue Plywood) Modified Dry-Set Cement Mortar, or Improved Modified Dry-Set Cement Mortar.

G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grout Epoxy.

H. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout.

I. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework.

J. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone.

K. 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.

L. ANSI A108.20 - American National Standard Specifications for Exterior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs.

M. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar.

N. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation.

O. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone.

P. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation.

Q. ANSI A137.1 - American National Standard Specifications for Ceramic Tile.

R. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.

S. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board.

T. SCAQMD 1113 - Architectural Coatings.

U. SCAQMD 1168 - Adhesive and Sealant Applications.

V. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting at the Project Site one week before starting work of this section; require attendance by affected installers.
   1. Review substrate preparation requirements.
   2. Review each type of tile, mortar, grout, and TCNA installation methods.
   3. Review requirements for waterproofing and/or crack isolation membrane(s).

1.03 SUBMITTALS

A. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

B. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
   1. Include waterproofing details at floor drains, shower pans, cove base, and thresholds.

C. Installer's Qualification Statement.
   1. Submit documentation of National Tile Contractors Association (NTCA) or Tile Contractors' Association of America (TCAA) accreditation.
   2. Submit documentation of completion of apprenticeship and certification programs.

D. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Installer shall have documented experience of work similar in scope, materials, and design to that indicated for this Project, with a record of successful in-service performance, with references upon request. Installer shall hold company-wide accreditation or employ individuals with one of the listed certifications (comply with at least one):
   1. Company-wide accreditation from one of the following:
      a. Accredited Five-Star member of the National Tile Contractors Association (NTCA) or Trowel of Excellence member of the Tile Contractors' Association of America (TCAA).
   2. Installer Certification:
      a. Ceramic Tile Education Foundation (CTEF): Certified Tile Installer (CTI).
      b. Apprenticeship Program: Installer has achieved Journeyworker status through an apprenticeship from the International Union of Bricklayers and Allied Craftworkers (IUBAC) or a U.S. Department of Labor (DOL)-recognized program.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store tile, grout, and mortar off the ground, protected from weather and water infiltration.

B. Store products in unopened containers or packages until ready for use.

C. Protect materials from freezing or overheating in accordance with manufacturer's instructions.

1.06 FIELD CONDITIONS

A. Do not install solvent-based products in an unventilated environment.

B. Maintain ambient and substrate temperature and humidity at levels required by referenced ANSI and TCNA tile standards, and per manufacturer's instructions.

PART 2 PRODUCTS

2.01 TILE

A. Source Limitations: Provide all products of each type by the same manufacturer.

B. Glazed Wall Tile, Type GWT-1: ANSI A137.1 standard grade.
   1. Size: To match existing.
   2. Edges: Cushioned.
   3. Surface Finish: To match existing.
   4. Color(s): To match existing.
   5. Trim Units: Matching bead, bullnose, cove, and base shapes in sizes coordinated with field tile.
   6. Products:
      a. American Olean; a division of Dal-Tile Corporation; Matte.
      b. Dal-Tile Corporation; Matte.
      c. Interceramic, USA; IC Mattes.
      d. Substitutions: See Section 016000 - Product Requirements.

C. Porcelain Tile, Type P-TILE-A1 and Type P-Tile-A2: ANSI A137.1 standard grade.
   1. Size: Match existing tile
   2. Color(s): Match existing tile
   3. Trim Units: Matching bullnose, cove base, and cove shapes in to match existing tile.
   4. Products:
      a. American Marazzi Tile, Inc.
      b. American Olean; a division of Dal-Tile Corporation.
      c. Crossville, Inc.
      d. Dal-Tile Corporation.
      e. Florim USA.
      f. GranitiFiandre; c/o Trans Ceramica, Ltd.
      g. Interceramic.
      h. Iris US.
      i. Laufen.
      j. Lone Star Ceramics Company.
      k. Porcelanite-Lamosa.
      l. Portobello America, Inc.
      m. Seneca Tiles, Inc.
      n. United States Ceramic Tile Company.
      o. Substitutions: See Section 016000 - Product Requirements.

2.02 TRIM AND ACCESSORIES

A. Non-Ceramic Trim: Satin brass anodized extruded aluminum, style and dimensions to suit application, for setting using tile mortar or adhesive.
   1. Applications:

a. Open edges of wall tile.
b. Open edges of floor tile.
c. Wall corners, outside and inside.
d. Transition between floor finishes of different heights.
e. Thresholds at door openings.
f. Expansion and control joints, floor and wall.
g. Floor to wall joints.
h. Borders and other trim as indicated on drawings.

2. Manufacturers:
a. Schluter-Systems.
b. Genesis APS International.
c. Blanke.
d. Ceramic Tool Company (CTC).
e. Substitutions: See Section 016000 - Product Requirements.

B. Thresholds: 2 inches wide by full width of wall or frame opening; beveled edge on both long edges; without holes, cracks, or open seams.
1. Material: Marble, honed finish.
2. Applications:
a. At doorways where tile terminates.

2.03 SETTING MATERIALS

A. Provide setting and grout materials from same manufacturer.

B. Modified Dry-Set Mortar (Thinset): ANSI A118.4.
1. Applications: Use this type at all locations where thinset mortar is indicated, unless otherwise indicated.
2. Products:
a. Custom Building Products; VersaBond Professional Thin-Set Mortar.
b. H.B. Fuller Construction Products, Inc.; TEC Full Flex TA 390/391.
c. LATICRETE International, Inc.; 252 Silver.
d. MAPEI Corporation; Ultraflex 2.
e. Summitville Tiles, Inc.; S-1000 MP Thin-Set Latex Mortar.
f. Substitutions: See Section 016000 - Product Requirements.

C. Latex-Portland Cement LHT Mortar (Medium-Bed): ANSI A118.4.
1. Applications: Use this type of bond coat where Large and Heavy Tile (LHT) mortar is indicated, in a 1/4- to 3/8-inch thick medium-bed application.
2. Products:
a. Custom Building Products; ProLite Premium Rapid Setting Large Format Tile Mortar, with Multi-Surface Bonding Primer.
b. H.B. Fuller Construction Products, Inc; TEC Ultimate Large Tile Mortar.
c. LATICRETE International, Inc; 257 TITANIUM.
d. MAPEI Corporation; Ultraflex LFT.
e. Merkrete, by Parex USA, Inc; Merkrete 735 Premium Flex.
f. Summitville Tiles, Inc.; S-1200 MP Premium Medium Bed Mortar.
g. Substitutions: See Section 016000 - Product Requirements.

2.04 GROUTS

A. Provide setting and grout materials from same manufacturer.

B. High Performance Polymer Modified Grout: ANSI A118.7 polymer modified cement grout.
   1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
   2. Use sanded grout for joints 1/8 inch wide and larger; use unsanded grout for joints less than 1/8 inch wide.
   3. Color(s): To be selected by Architect from manufacturer's full range.
   4. Products:
      a. Custom Building Products; Prism Color Consistent Grout.
      b. H.B. Fuller Construction Products, Inc; TEC AccuColor Plus Grout.
      c. LATICRETE International, Inc; LATICRETE PERMACOLOR Grout.
      d. MAPEI Corporation; Ultracolor Plus.
      e. Merkrete, by Parex USA, Inc; Merkrete Pro Grout.
      f. Substitutions: See Section 016000 - Product Requirements.

2.05 MAINTENANCE MATERIALS

A. Tile Sealants: Moisture- and mildew-resistant type sealants; one-part silicone for wall applications and multi-part urethane for floor applications. Sealants and accessories shall comply with requirements below and with requirements of Division 7 Section "Joint Sealants."
   1. Color(s): As selected by Architect from manufacturer's full line. Sealant colors shall match grout colors in adjacent joints unless otherwise indicated.
   2. Low-Emitting Materials:
      a. Adhesives and Sealants: Adhesives and sealants field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with CAL (CDPH SM) AND shall meet the chemical content requirements of SCAQMD 1168.
   3. Silicone Sealant (Walls): ASTM C 920, Type S, Grade NS, Class 25; Uses NT (non-traffic), G (glass), A (aluminum), O (other substrates indicated).
      a. Products:
         1) GE Silicones, a division of GE Specialty Materials; SCS1700 Sanitary.
         2) Pecora Corporation; Pecora 898 NST.
         3) Tremco Inc.; Tremsil 200.
         4) Substitutions: See Section 016000 - Product Requirements.
   4. Urethane Sealant (Floors): ASTM C 920, Type M, Grade P, Class 25; Uses T (traffic), M (mortar), A (aluminum), O (other substrates indicated).
      a. Products:
         1) Master Builders Solutions; MasterSeal SL 2.
         2) Pecora Corporation; NR-200 Urexpan.
         3) Sika Corporation; Sikaflex-2c SL.
         4) Tremco Inc.; THC-901.
         5) Substitutions: See Section 016000 - Product Requirements.
   5. Sealant Accessories: Provide backer rod, primer, and other sealant accessories as recommended by sealant manufacturer for applications required.

B. Grout Sealer: Liquid-applied, penetrating, moisture and stain protection for existing or new Portland cement grout.
   1. Composition: Water-based colorless silicone.
   2. Products:
      a. Custom Building Products; Aqua Mix Sealer's Choice Gold.
      b. Merkrete, by Parex USA, Inc; Merkrete Grout Sealer.
      c. SGM, Inc.; Grout Sealer.
      d. Summitville Tiles, Inc.; SL-99 Summitseal II.
      e. Substitutions: See Section 016000 - Product Requirements.

C. Tile Sealer: Stain protection for exposed surfaces of unglazed ceramic tile, other porous tile, and grout. Provide penetrating sealer with no sheen, preserving natural tile appearance.
   1. Products:
      a. Custom Building Products; Aqua Mix Sealer's Choice Gold.
      b. Rust-Oleum Corporation; Miracle Sealants 511 Impregnator Natural Looking Penetrating Sealer.
      c. STONETECH, a division of LATICRETE international, Inc; STONETECH Heavy Duty Sealer.
      d. Substitutions: See Section 016000 - Product Requirements.

D. Grout Release: Temporary, water-soluble pre-grout coating.
   1. Products:
      a. Custom Building Products; Aqua Mix Grout Release.
      b. MAPEI Corporation; UltraCare Grout Release.
      c. Substitutions: See Section 016000 - Product Requirements.

2.06 ACCESSORY MATERIALS

A. Low-Emitting Materials:
   1. Paints and Coatings: Paints and coatings field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with CAL (CDPH SM) AND shall meet applicable VOC limits of CARB (SCM) or SCAQMD 1113.
   2. Adhesives and Sealants: Adhesives and sealants field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with CAL (CDPH SM) AND shall meet the chemical content requirements of SCAQMD 1168.

B. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; not intended as waterproofing.
   1. Crack Resistance: No failure at 1/8 inch gap, minimum.
   2. Peel-and-Stick Sheet Type:
      a. Material: Rubberized membrane laminated to reinforcing fabric.
      b. Thickness: 40 mils, nominal.
      c. Products:
         1) Boiardi Products Corp.; a QEP company; Elastiment 340 Sound Control Sheet Membrane Waterproofing and Anti-Fracture/Crack-Suppression System.
         2) Custom Building Products; Crack Buster Pro-Crack Prevention Mat Underlayment.
         3) MAPEI Corporation; Mapeguard 2.
         4) National Applied Construction Products, Inc.; ECB Anti-Fracture Membrane.

5) Substitutions: See Section 016000 - Product Requirements.

C. Waterproofing Membrane: 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 with Embedded Reinforcing Fabric:
      a. Material: Synthetic rubber or Acrylic.
      b. Thickness: 30 mils, minimum, dry film thickness.
      c. Products:
         1) Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane.
         2) H.B. Fuller Construction Products, Inc; TEC HydraFlex Waterproofing Crack Isolation Membrane.
         3) LATICRETE International, Inc; 9235 Waterproofing Membrane.
         4) MAPEI Corporation; Mapelastic AquaDefense.
         5) Merkrete, by Parex USA, Inc; Merkrete Hydro Guard 2000.
         6) Summitville Tiles, Inc.; S-9000.
         7) Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work, per ANSI A108.01, 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 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. For ease of cleaning and to prevent staining, precoat tile with temporary grout release. For unglazed ceramic and other porous tile types, provide either combination tile sealer/grout release, or a temporary grout release with final tile sealer applied after tile installation.

3.03 INSTALLATION - GENERAL

A. Mortar Types: Provide modified dry-set mortar in a standard thin-set bed except as indicated:
   1. Provide LHT mortar in a 1/4- to 3/8-inch medium bed at all large format tile (tile 12 inches or greater in any dimension).

B. Grout Types: Grout all tile joints unless otherwise indicated. Provide high-performance polymer-modified grout except as indicated:
   1. Provide epoxy grout in toilet, shower, and locker rooms, custodial/janitorial rooms, and other spaces subject to water.

C. Install tile and thresholds and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.20, manufacturer's instructions, and TCNA (HB) recommendations.

D. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

E. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.

F. 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.

G. Form internal angles square and external angles bullnosed.

H. Install non-ceramic trim in accordance with manufacturer's instructions.

I. Install thresholds where indicated.

J. Sound tile after setting. Replace hollow sounding units.

K. Keep control and expansion joints free of mortar, grout, and adhesive.

L. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

M. 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.

3.04 INSTALLATION - FLOORS - THIN-SET METHODS

A. Over new interior concrete substrates, install in accordance with TCNA (HB) Method F122/F122A, over combination waterproofing/crack-isolation membrane.

B. Over existing interior concrete substrates on grade, install in accordance with TCNA (HB) Method F125-Full, over full coverage crack-isolation membrane.

C. Install tile-to-tile floor movement joints in accordance with TCNA (HB) Method EJ171F.

3.05 INSTALLATION METHODS - WALL TILE

A. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244, using membrane at toilet rooms.

B. Over interior concrete / masonry install in accordance with TCNA (HB) Method W202.

3.06 CLEANING

A. Clean tile and grout surfaces.

3.07 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION 093000

SECTION 095100
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

C. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

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.

F. ASTM E1264 - Standard Classification for Acoustical Ceiling Products.

1.02 SUBMITTALS

A. Shop Drawings: Indicate grid layout and related dimensioning.

B. Product Data: Provide data on suspension system components, acoustical units, and specialty ceiling products as indicated.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Refer to Section 016000 - Product Requirements, for additional provisions.
   2. Extra Acoustical Panels: Quantity equal to 2 percent of total installed, of each type.

D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.03 QUALITY ASSURANCE

A. Source Limitations: Provide each acoustical ceiling assembly (ceiling panel and suspension system) from a single manufacturer to obtain manufacturer's system warranty.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver until building is weather-tight and conditioned.

B. Store materials in dry and clean location until needed for installation. During installation, handle in a manner that will prevent damage and to prevent marring and soiling of finished surfaces.

1.05 FIELD CONDITIONS

A. Maintain uniform temperature and humidity at occupancy conditions during and after acoustical unit installation. Allow products to acclimatize prior to installation.

1.06 WARRANTY

A. System Warranty: Provide a single source system warranty covering both acoustical ceiling panels and suspension system.
   1. Warranty shall cover material failures including sag, warping, shrinkage, or delamination, biologic growth including mold or mildew, and rusting of suspension system.
   2. Warranty Period: Minimum 15 years, from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Each acoustical ceiling shall be Class A rated, with flame spread index of 25 or less, smoke developed index of 50 or less, when tested in accordance with ASTM E84.

B. Seismic Performance: Ceiling systems designed to withstand the effects of earthquake motions determined according to ASCE 7, which references applicable requirements of ASTM E580/E580M "Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Subject to Earthquake Ground Motions." for Seismic Design Category indicated on Structural Drawings and complying with local authorities having jurisdiction.

2.02 ACOUSTICAL PANELS

A. Acoustical Panels - General: ASTM E1264, Class A.
   1. Antibacterial/Antimicrobial Treatment: Provide acoustical panels that have been factory-treated by manufacturer for resistance to bacteria, mold, mildew, and fungus.
   2. Humidity/Sag Treatment: Provide acoustical panels that have been factory-treated by manufacturer for humidity and sag-resistance.

B. Acoustical Panels ACP-A: Painted mineral fiber, with the following characteristics:
   1. Classification: ASTM E1264, Type III.
      a. Form: 2, water felted.
   2. Size: 24 by 24 inches.
   3. Thickness: 5/8 inches.
   4. Light Reflectance: Not less than 0.80, determined in accordance with ASTM E1264.
   5. NRC Range: Not less than 0.55, determined in accordance with ASTM E1264.
   6. Panel Edge: Square.
   7. Tile Edge: Square.
   8. Color: White.
   9. Suspension System: Exposed grid.
   10. Products:
      a. Armstrong World Industries, Inc; Fine Fissured - Item #1728.
      b. CertainTeed; Fine Fissured - Item #HHF-157.
      c. USG Corporation; Radar Acoustical Panels - Item #2210.
      d. Substitutions: See Section 016000 - Product Requirements.

2.03 SUSPENSION SYSTEM(S)

A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
   1. Materials:
      a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.
   2. Cross Tee/Main Runner Connection: Override (stepped).
   3. Main Runner End Coupling: Bayonet ("stab") type; knuckle type is not acceptable.

B. Exposed Suspension System: Hot-dipped galvanized steel grid with aluminum cap.

1. High Humidity Applications: Provide in kitchens, rooms with showers, custodial rooms, mechanical rooms, and other rooms where increased corrosion resistance due to humidity or steam is required.
2. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
3. Coating: Provide minimum G60 hot-dip galvanized coating.
4. Profile: Tee; 15/16 inch face width.
5. Finish: Baked enamel.
6. Color: White.
7. Products:
   a. Armstrong World Industries, Inc; Prelude Plus XL Fire Guard.
   b. CertainTeed Ceilings, Inc; 15/16" EZ Stab Classic Environmental System.
   c. USG Corporation; Donn Brand ZXLA 15/16 inch Acoustical Suspension System.
   d. Substitutions: See Section 016000 - Product Requirements.

2.04 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

B. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.

C. Perimeter Moldings: Same metal and finish as grid.
   1. Acoustical Sealant For Perimeter Moldings: Refer to Section 079200 - Joint Sealants for acoustical sealant for use in conjunction with suspended ceiling system.

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 PREPARATION

A. Install after major above-ceiling work is complete.

B. Coordinate the location of hangers with other work.

3.03 INSTALLATION - SUSPENSION SYSTEM

A. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

B. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.

C. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Use longest practical lengths.
   2. Apply acoustical sealant in a continuous bead at top edge of vertical legs of moldings after they are installed.

D. 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.

1. Do not hang suspension system directly from steel floor or roof deck.

E. 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.

F. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

G. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

H. Do not eccentrically load system or induce rotation of runners.

3.04 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 acoustical units level, in uniform plane, and free from twist, warp, and dents.

E. Cutting Acoustical Units:

1. Make field cut edges of same profile as factory edges.

F. Where round obstructions and bullnose concrete block corners occur, provide preformed closures to match perimeter molding.

3.05 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.

END OF SECTION 095100

SECTION 096513
RESILIENT BASE AND ACCESSORIES

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.

B. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile.

C. ASTM F1861 - Standard Specification for Resilient Wall Base.

D. ASTM F2169 - Standard Specification for Resilient Stair Treads.

E. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

1.02 SUBMITTALS

A. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

B. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.

C. Verification Samples: Submit in manufacturer's standard size, illustrating color and pattern for each resilient flooring product specified.

1.03 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. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

C. Protect roll materials from damage by storing on end.

1.04 FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

B. Maintain conditions at occupancy conditions for installation and until Substantial Completion.

PART 2 PRODUCTS

2.01 RESILIENT BASE

A. Resilient Base: ASTM F1861, Type TP, rubber, thermoplastic; Style B, Cove.
   1. Products (Type TP):
      a. Armstrong World Industries, Inc.; Rubber Coved Toe Wall Base.
      b. Flexco (USA), Inc.; Flexco Base 2000 - Cove.
      c. Johnsonite, a Tarkett Company; Rubber Wall Base - Cove.
      d. Mannington Commercial; Burkebase Type TP - Coved.
      e. Nora Systems, Inc; nora wall base; Article 820.
      f. Roppe Corporation; 700 Series TPR Wall Base - Style B (Coved).

g. Substitutions: See Section 016000 - Product Requirements.

2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
3. Height: 4 inch.
4. Thickness: 0.125 inch minimum.
5. Finish: Satin.
6. Length: Roll; manufacturer's standard length.
7. Color: To be selected by Architect from manufacturer's full range.

2.02 MOLDINGS, TRANSITIONS, AND EDGE STRIPS

A. Moldings, Transition and Edge Strips:
1. Manufacturers:
a. Flexco, Inc.
b. Johnsonite.
c. Mannington Commercial.
d. R.C.A. Rubber Company (The).
e. Roppe Corporation.
f. VPI, LLC; Floor Products Division.
g. Substitutions: See Section 016000 - Product Requirements.
2. Molding/Transition Strip Profiles: Provide in sizes as required to suit flooring thicknesses and applications.
a. Coved edge/cap for carpet.
b. Joiner between carpet and resilient flooring or other materials with different heights.
c. Transition strip between different types of materials that are the same height or between different styles/patterns of the same material.
d. Slim transition strip with approximately 1/4-inch wide visible transition profile.
e. Reducer strip at edges of flooring to reduce height to 0".
f. Subfloor leveling accessory to transition between materials with height differences up to 1/2 inch.
3. Material: Manufacturer's standard rubber or vinyl.
4. Color: To be selected by Architect from manufacturer's full range.

2.03 ACCESSORIES

A. Leveling Compound: Blended cement mix, latex-modified, for use as trowelable underlayment, approved by resilient accessory manufacturer.

B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.

C. Moisture Vapor Treatment: Where resilient flooring and accessories are installed over concrete slabs, provide alkaline-resistant product designed to control excessive moisture vapor transmission through concrete slab, per the following:
1. Products: Provide product approved by flooring manufacturer and complying with performance requirements below, equivalent to one of the following:
a. Duraamen Engineered Products, Inc.; Perdure MVT.
b. Maxxon Corporation; Maxxon MVP.
c. Tnemec Company Inc.; Epoxoprime MVT, Series 208.

2. Performance Requirements:
    a. Verify with flooring manufacturer that submitted product maintains compliance with all provisions of flooring manufacturer's warranty.
    b. Low-VOC: Provide product with VOC content less than 15 g/L.
    c. Bond Strength to Concrete: Minimum 400 psi per ASTM D 4541 (100% concrete failure).
    d. Permeance: Maximum 0.1 perm per ASTM E 96, and 0.10 grains/hr/ft^2/in-Hg, per ASTM F3010.
    e. Applications: Provide MVT for all concrete slabs on-grade and lightweight concrete elevated slabs.

D. Floor Polish: Fluid-applied polish recommended by resilient flooring manufacturer.

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 wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
    1. Do not apply wall base until other finish items, including casework and painting, are complete.

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 leveling compound to achieve smooth, flat, hard surface.

C. Prohibit traffic until leveling compound is fully cured.

D. Clean substrate.

3.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Adhesive-Applied Installation:
    1. Fit joints and butt seams tightly.
    2. Set flooring in place, press with heavy roller to attain full adhesion.

D. Where type of floor finish, pattern, or color are different on opposite sides of door, install such that molding profiles or transition strips are centered under the door panel.

E. Install edge/reducer strips at unprotected or exposed edges, where flooring terminates, and where indicated.
    1. Resilient Strips: Attach to substrate using adhesive.

3.04 INSTALLATION - RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.

B. Install base on solid backing. Bond tightly to wall and floor surfaces.

C. Job form internal and external corners in accordance with manufacturer's instructions. Form corners by "V" cutting or scribing; do not bend material in a manner that creates stress whitening.

D. In addition to walls, install base on other permanent construction with exposed vertical faces at floor level, including, but not limited to, columns, pilasters, and casework/cabinet knee and toe spaces.

E. Scribe and fit to door frames and other interruptions.

F. At uneven substrate surfaces (such as masonry mortar joints), provide manufacturer's recommended filler sealant or adhesive to fill voids along top of base.

3.05 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

3.06 PROTECTION

A. Prohibit traffic on resilient accessories for 48 hours after installation.

B. Cover resilient accessories and protect from heavy construction traffic and equipment until Substantial Completion.

END OF SECTION 096513

SECTION 096519
RESILIENT TILE FLOORING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.

B. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

C. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

1.02 SUBMITTALS

A. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

B. Shop Drawings: Indicate seaming plans, floor patterns, and dye lot.

C. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.

D. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.

E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.03 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. Store all materials off of the floor in an acclimatized, weather-tight space.

C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

1.04 FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

1.05 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Manufacturer's Warranty: Provide a ten (10) year manufacturer warranty, covering defective material and installation.

C. Installer's Warranty: Installer shall warrant that the products have been installed in accordance with manufacturer's instructions.

1. The installer shall provide a ten (10) year warranty against product failure due to excessive moisture vapor transmission through the slab.

PART 2 PRODUCTS

2.01 RESILIENT TILE FLOORING

A. Vinyl Composition Tile - VCT: Homogenous, with pattern and color extending throughout thickness of the tile. "Through-color" is not acceptable.
   1. Manufacturers:
      a. AHF Contract; Iliad/Highlights.
      b. Armstrong Flooring; Standard Excelon Imperial Texture.
      c. Tarkett; VCT II.
      d. Vinylasa; Nova.
      e. Substitutions: See Section 016000 - Product Requirements.
   2. Minimum Requirements: Comply with ASTM F1066, Class 2 ("through-pattern").
   3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
   4. Size: 12 by 12 inch.
   5. Thickness: 0.125 inch.
   6. Pattern: As indicated on the drawings..
   7. Color: As indicated on drawings, to match existing.

2.02 ACCESSORIES

A. Subfloor Filler: Type recommended by adhesive material manufacturer.

B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.

C. Floor Polish: Fluid-applied polish recommended by resilient flooring manufacturer.

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. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
   1. Test as Follows: Perform one of each test per 1,000 sf of installation area.
      a. Alkalinity (pH): ASTM F710.
      b. Internal Relative Humidity: ASTM F2170.
      c. Moisture Vapor Emission: ASTM F1869.
   2. If test results are not within limits recommended by flooring manufacturer, apply moisture vapor treatment (MVT) in accordance with manufacturer's requirements. MVT shall be provided per unit price and quantity allowance requirements.

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. Clean substrate.

3.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Adhesive-Applied Installation:

1. Fit joints and butt seams tightly.
2. Set flooring in place, press with heavy roller to attain full adhesion.

D. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

E. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.

F. 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. Lay flooring with joints and seams parallel to building lines to produce symmetrical pattern, unless otherwise indicated.

3.05 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

C. Polish: Apply not less than three coats of floor polish. Provide additional coats as required to comply with manufacturer's recommendations.

3.06 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION 096519

SECTION 096817
TEXTILE COMPOSITE FLOORING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. AATCC Test Method 16 - Colorfastness to Light.

B. AATCC Test Method 134 - Test Method for Electrostatic Propensity of Carpets.

C. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials.

D. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.

E. ASTM E662 - Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.

F. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.

G. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

H. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

I. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.

J. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

K. SCAQMD 1168 - Adhesive and Sealant Applications.

1.02 DEFINITION

A. Textile Composite Flooring: A hybrid floor covering consisting of a tufted loop nylon or polyester fiber wear layer thermally fused to a cushioned polyester backing, commonly referred to as textile composite flooring (TCF), vinyl cushion tufted textile (VCTT), or tufted textile flooring.

1.03 SUBMITTALS

A. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

B. Selection Samples: Submit manufacturer's standard color charts illustrating color and pattern design for each TCF product specified.

C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

D. Manufacturer's Qualification Statement.

E. Installer's Qualification Statement.

F. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 016000 - Product Requirements, for additional provisions.

2. Extra TCF Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed, but not less than 10 square yards.

H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified textile composite flooring. Manufacturer shall have a technical field representative available for field observation and inspection.

B. Installer Qualifications: Company specializing in installing textile composite flooring, and complying with following:
   1. Installer shall be a specialty contractor normally engaged in the installation of TCF flooring, with prior experience installing these floor materials. Flooring contractor shall submit a list of installers certified by TCF manufacturer prior to bid.
   2. Flooring contractor shall be responsible for proper product installation, including floor substrate testing and preparation, in accordance with manufacturer's requirements and specifications.

1.05 FIELD CONDITIONS

A. Do not deliver or install until building is enclosed and HVAC system is operating at occupancy conditions.

B. Store materials in area of installation for minimum period of 24 hours prior to installation.

1.06 WARRANTY

A. Manufacturer's Warranty: The TCF warranty shall be the sole source responsibility of the manufacturer. Second source warranties or warranties that involve parties other than the TCF manufacturer are unacceptable.
   1. Warranty Term: 10 years minimum.
   2. In the event of failure due to material or workmanship, the warranty shall cover either repair or removal and replacement at manufacturer's discretion.
   3. The warranty shall not exclude TCF installed on stairs, provided the product installation was approved by manufacturer's field representative during final inspection, and provide the product was properly maintained.
   4. Wear Layer Warranty: Shall specifically define and cover against the following:
      a. Product performance.
      b. Colorfastness to light and crocking.
      c. Stain removal.
      d. Static protection.
      e. Zippering.
   5. Backing Layer Warranty: Shall specifically define and cover against the following:
      a. Edge ravel.
      b. Delamination.
      c. Dimensional stability.
   6. A 'tuft bind' warranty in lieu of edge ravel and zippering is not acceptable.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Textile Composite Flooring ("TCF"):
   1. J&J Flooring Group, Inc.; Kinetex.
   2. Patcraft; Walk Right In II.
   3. Tandus Centiva; Powerbond Hybrid Resilient.
   4. Substitutions: See Section 016000 - Product Requirements.

2.02 PERFORMANCE CHARACTERISTICS

A. The following performance characteristics shall be met by all products:
   1. Critical Radiant Flux: Minimum of 0.45 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
   2. Surface Flammability Ignition: Pass Federal Flammability CPSC FF 1-70 (also referenced as ASTM D2859 - the "pill test").
   3. Maximum Electrostatic Charge: Pass AATCC Test Method 134 (Step & Scuff): 3 Kv. or less at 20 percent relative humidity.
   4. Smoke Density: ASTM E662 / NFPA 258: < 450 Flaming Mode.
   5. Static Coefficient of Friction: ASTM C1028: Passes ADA Guidelines for Accessible Routes (Minimum 0.60).
   6. Delamination of Secondary Backing of Pile Floor Coverings: ASTM D3936: Minimum 15 lbs.
   7. Lightfastness: AATCC Test Method 16: > 4 @ 100 hours.
   8. Vetterman Drum: ASTM D5417: Minimum 3 @ 22,000 cycles.
   9. Seam Integrity: Seam to remain intact after 50,000 cycles per Phillips Chair Test.

B. Low-Emitting Materials:
   1. Flooring Products: Flooring products shall be tested and determined compliant in accordance with CAL (CDPH SM).
   2. Adhesives and Sealants: Adhesives and sealants field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with CAL (CDPH SM) AND shall meet the chemical content requirements of SCAQMD 1168.

2.03 MATERIALS

A. Textile Composite Flooring, Type TCF-A: Tufted or flocked, manufactured in one color dye lot.
   1. Product: Strata manufactured by J&J Flooring Group.
   2. Tile Size: 24 by 24 inch, nominal.
   3. Color: 1853 Volcanic.
   4. Wear Layer: Manufacturer's standard, polyester or nylon.
   5. Primary Backing Material: 100% Polyester felt cushion.

2.04 ACCESSORIES

A. Subfloor Filler: Type recommended by flooring material manufacturer.

B. Edge Strips: Embossed aluminum, color as selected by Architect.

C. Adhesive: Recommended by textile composite flooring manufacturer; releasable type.

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 textile composite flooring.

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 as Follows: Perform one of each test per 1,000 sf of installation area.
      a. Alkalinity (pH): ASTM F710.
      b. Internal Relative Humidity: ASTM F2170.
      c. Moisture Vapor Emission: ASTM F1869.
   2. After testing is complete, prepare concrete and install moisture vapor treatment (MVT) in accordance with manufacturer's written instructions. If testing indicates measurements are within acceptable levels for flooring installation with the need for MVT, the MVT may be omitted where approved by the Architect.

3.02 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.

C. Apply moisture vapor treatment (MVT) in accordance with manufacturer's instructions.

D. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.

3.03 INSTALLATION

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install TCF in accordance with manufacturer's instructions.

C. Cut TCF tile clean. Fit TCF tight to intersection with vertical surfaces without gaps.

D. Lay TCF tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.

E. To ensure minimal color variation, ensure that each space/room uses only carpet from the same dye lot.

F. Locate change of color or pattern or transition trim between rooms under door centerline.

G. Fully adhere TCF tile to substrate.
   1. Free-lay and stretch-in installations are not acceptable.

H. Trim TCF neatly at walls and around interruptions.

I. Complete installation of edge strips, concealing exposed edges.

3.04 FIELD QUALITY CONTROL

A. Engage manufacturer's technical field representative to observe during substrate preparation and during installation, and to provide a final inspection after completion.

B. Remove and replace TCF where manufacturer's field inspection indicates that installation is not in compliance with the specified requirements or with manufacturer's instructions.

3.05 CLEANING AND PROTECTION

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.

B. Clean and vacuum TCF surfaces.

C. Protect installed TCF from heavy construction traffic, soiling, and damage for the remainder of the construction period.

END OF SECTION 096817

SECTION 099100
PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish exterior and interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated. Specific items include (but are not limited to) the following:

1. Fire- and Smoke-Rated Wall Identification: Permanently label fire- and smoke-rated walls, partitions, and barriers per requirements of applicable building code. Labeling shall include fire-resistance rating, type of assembly, and instruction to protect openings/penetrations. Example text: "ONE HOUR FIRE BARRIER - PROTECT ALL OPENINGS".
    a. Locate lettering in concealed accessible floor, floor-ceiling plenums, and attic spaces, located no more than 15 feet from end of wall and at horizontal intervals not exceeding 30 feet, with stenciled lettering not less than 3 inches high with minimum 3/8-inch strokes. Locate directly inside of access doors or panels that provide access to rated walls. Do not paint walls where exposed to view except in support spaces (mechanical / electrical rooms and similar spaces).
2. Refer to the life safety plans and partition schedule on the drawings for rated wall and partition locations.
3. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
4. Elevator pit ladders.
5. Prime surfaces to receive wall coverings.
6. Mechanical and Electrical:
    a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
    b. 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.
    c. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
7. Shop-Primed Items: In finished areas, paint shop-primed items. Unless specifically indicated that additional field primer is not required, provide a tie coat primer over the shop primer before top coat(s) are applied.

D. Do Not Paint or Finish the Following Items:

1. Items factory-finished unless otherwise 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, bar code labels, and operating parts of equipment.
5. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, and lead items.

6. Marble, granite, slate, and other natural stones.
7. Floors, unless specifically indicated.
8. Ceramic and other tiles.
9. Brick, architectural concrete, architectural precast, cast stone, and integrally colored plaster, fiberglass, or stucco.
10. Glass.
11. Acoustical materials, unless specifically indicated.
12. Concealed pipes, ducts, and conduits.

1.02 REFERENCE STANDARDS

A. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.

B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual.

C. SSPC-SP 1 - Solvent Cleaning.

D. SSPC-SP 6 - Commercial Blast Cleaning.

1.03 SUBMITTALS

A. Product Data: Provide complete list of 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. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

1.04 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.

1.05 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. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F above the dew point, or to damp or wet surfaces.

D. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Paints:
   1. Benjamin Moore.
   2. PPG Paints.
   3. Sherwin-Williams Company.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
   1. Provide paints and finishes 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.
   2. Supply each paint material in quantity required to complete entire project's work from a single production run.
   3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Low-Emitting Materials (Paints and Coatings): Paints and coatings field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with CAL (CDPH SM) AND shall meet applicable VOC limits of CARB (SCM) or SCAQMD 1113.

2.03 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

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. Test shop-applied primer for compatibility with subsequent cover materials.

D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
   1. Gypsum Wallboard: 12 percent.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to 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 repair existing paints or finishes that exhibit surface defects.

D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

E. Seal surfaces that might cause bleed through or staining of topcoat.

F. Concrete:
   1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

G. Masonry:
   1. Remove efflorescence and chalk. Do not coat surfaces if moisture content, alkalinity of surfaces, or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.

H. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.

I. Galvanized Surfaces:
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

J. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
   2. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.

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 written instructions and recommendations in "MPI Architectural Painting Specification Manual".

C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.

D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

E. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

F. Sand wood and metal surfaces lightly between coats to achieve required finish.

G. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

H. 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 finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

3.06 INTERIOR PAINT SCHEDULE

A. General: Provide the following paint systems for the various substrates, as indicated. Dry film thickness is noted as “DFT.” Provide compatibility test areas on existing painted substrates.

B. Concrete Masonry Units: Low-VOC Acrylic Satin Finish. 2 Coats over filler, with total DFT not less than 2.5 mils. (Provide for CMU except where “epoxy finish” is indicated.)
   1. Filler Coat, 100% Acrylic. Apply filler coat at a rate to ensure complete coverage. Brush, spray or roller apply and back roll or squeegee for smooth, pinhole-free treatment.
      a. Moore: 571 Ultra Spec Hi-Build Masonry Block Filler.
      b. PPG: 16-90 Pitt Glaze WB Acrylic Interior Exterior Block Filler.
      c. S-W: B46W150 Pro Industrial Heavy Duty Block Filler. (PrepRite not acceptable)
   2. Waterproofing Filler Coat – Showers & Wet Applications: Cementitious resin or epoxy block filler applied by brush, spray or roller and back rolled or squeegeed for smooth, pinhole-free treatment.
      a. Moore: P31 Waterborne Epoxy Block filler.
      b. PPG: 95-217 Epoxy Ester Cementitious Waterproofing Block Filler.
      c. S-W: B42W400/B42V401 Kem Cati-Coat HS Epoxy Filler/Sealer.
   3. Bonding Primer (previously painted): Acrylic bonding primer for exceptional adhesion to hard, glossy surfaces. Test for adhesion. Brush, spray or roller apply and back roll.
      a. Moore: Stix Bonding Primer.
      b. PPG: 17-921 PPG Seal Grip Acrylic Universal Primer/Sealer.
      c. S-W: B51W150 Extreme Bond Interior/Exterior Primer.
   4. First & Second Finish Coats: Commercial Interior Low-VOC Acrylic Satin Finish. Provide for wall finishes unless directed otherwise.
      a. Moore: N538 Ultra Spec 500 Interior Eggshell Finish.
      b. PPG: 6-411ZV Speedhide Interior Eggshell Latex.
      c. S-W: B20-12650 ProMar 200 Zero VOC Interior Latex Eg-Shel.

C. Concrete Masonry Units - Semi-Gloss Water-Borne Epoxy Finish: 2 Coats over filler:
   1. Block Filler Coat: Acrylic-latex or as required by manufacturer for topcoat. Brush, spray or roller apply and back roll for smooth pinhole-free treatment.
      a. Moore: 571 Ultra Spec Hi-Build Masonry Block Filler.
      b. PPG: 6-15 Speedhide Int/Ext Acrylic Masonry Block Filler.
      c. PPG: 16-90 Pitt-Glaze WB Int/Ext Block Filler Latex.
      d. S-W: B46W150 Pro Industrial Heavy Duty Block Filler.
   2. First and Second Coats: Two-component, semi-gloss water born polyamide epoxy enamel applied at a DFT of 1.5 to 4.0 mils per coat.
      a. Moore: Corotech V400 Polyamide Epoxy Coating.
      b. PPG: 98E-xx Base / 98E-100 Aquapon WB EP Water Based Epoxy – Semi-Gloss.
      c. S-W: B73W360 / B73V300 Pro Industrial Water Based Catalyzed Epoxy.

D. Concrete Floor with Epoxy Floor-Striping Enamel at Vehicle Bays: 2 Coats over primer on cured surface. Concrete must cure a minimum of 30 days before painting and have pH of 10.0 or lower. Prepare floor by means acceptable to paint manufacturer (accepted in writing) prior to painting.
   1. Primer Coat: Epoxy primer applied over prepared concrete.
      a. Moore: Corotech V155-00 100% Solids Epoxy Pre-Primer.
      b. PPG: Amerlock 2/400 Series primer.
      c. S-W: Macropoxy 646 Fast Cure (FC) Epoxy.
   2. Two Finish Coats: Two-component high solids epoxy floor enamel for traffic surface. Provide 4.0 - 8.0 mils DFT per coat or as recommended by manufacturer.

a. Moore: Corotech V440 Waterborne Amine Epoxy.
b. PPG: Amerlock 2.
c. S-W: Macropoxy 646 Fast Cure (FC) Epoxy.

E. Gypsum Board Systems with Latex Finish: Satin (egg-shell) finish at walls and flat finish on ceilings except as indicated otherwise. Provide best commercial Zero-VOC formulation with 0 VOC per EPA test method 24.
1. Filler Coat: 0 VOC (per EPS test method 24) Latex Primer.
a. Moore: N534 Ultra Spec 500 Interior Latex Primer.
b. PPG: 9-900 Pure Performance Interior Latex Primer.
c. S-W: B28-2600 ProMar 200 Zero VOC Interior Latex Primer.
2. First & Second Finish Coats: Interior Zero-VOC Acrylic Satin Finish. (Low lustre/Satin = 25-45% @60°) Provide for wall finishes unless indicated otherwise.
a. Moore: N538 Ultra Spec 500 Interior Eggshell.
b. PPG: 6-411ZV Speedhide Interior Eggshell Latex.
c. S-W: B20-12650 ProMar 200 Zero VOC Interior Latex Eg-Shel.
3. First & Second Finish Coats: Interior Zero-VOC Acrylic Flat Finish. Provide for ceiling applications unless indicated otherwise.
a. Moore: N536 Ultra Spec 500 Interior Flat.
b. PPG: 6-70ZV Speedhide Interior Latex Flat.
c. S-W: B30-2600 ProMar 200 Zero VOC Interior Latex Flat or B30-4650 ProMar 400 Zero VOC Interior Latex Flat.

F. Ferrous Metal with Latex Dry Fog Finish: One finish coat over primed exposed construction. Provide nominal 50 square foot sample area to test for paint compatibility with substrates.
1. Prime Coat: (Acrylic or recommended VOC-compliant metal primer for surfaces not pre-primed.) 2.0 mils DFT.
a. Moore: N110 Superkote 5000 DryFall Latex Flat.
b. PPG: 90-1908 Pitt-Tech Plus EP Acrylic Primer/Finish.
c. S-W: B66-1300 Series Pro Industrial Pro-Cryl Universal Acrylic Primer.
2. Top Coat: All exposed structure as scheduled. Acrylic Dry Fog 3.0 mils DFT. Provide color finish as selected by Architect from manufacturer's full range.
a. Moore: N110 Superkote 5000 DryFall Latex Flat.
b. PPG: 6-725XI Speedhide Super Tech WB Int. Dry-Fog Flat Latex Flat.
c. S-W: B42W1181 / B42B81 Waterborne Acrylic Dry Fall, Flat.

G. Ferrous Metal: Direct to Metal (“DTM”) Acrylic Enamel Finish: 2 Coats over primer, with total DFT not less than 2.5 mils. Provide satin finish at hollow metal steel doors and frames, and semi-gloss at other applications.
1. Prime Coat: Lead-free, acrylic base primer. Not required on shop primed items.
a. Moore: HP29 Ultra Spec HP DTM Acrylic Semi-Gloss.
b. PPG: 90-1908 Pitt-Tech Plus EP Acrylic Primer/Finish.
c. S-W: B66W11 Pro Industrial DTM Acrylic Primer/Finish (or B66 W200).
2. Bonding Primer (previously painted): Acrylic bonding primer designed for previously painted ferrous metal to ensure secure bond. Brush, spray or roller apply and back roll.
a. Moore: SXA-110 Insl-X Waterborne Bonding Primer.
b. PPG: 90-1908 Pitt-Tech Plus EP Acrylic Primer/Finish.
c. S-W: B66A50 DTM Bonding Primer.

3. First and Second Coat: DTM Acrylic Semi-Gloss Enamel. (30-40 units @ 60°)
    a. Moore: HP29 Ultra Spec HP DTM Acrylic Semi-Gloss.
    b. PPG: 90-1610 Pitt-Tech Plus EP DTM Acrylic Semi-Gloss.
    c. S-W: B66W1151 Pro Industrial DTM Acrylic Semi-Gloss Coating.
4. First and Second Coat: DTM Acrylic Satin Enamel. Provide for hollow metal steel doors and frames. (15-25 units @ 60°)
    a. Moore: HP25 Ultra Spec HP DTM Acrylic Low Lustre.
    b. PPG: 90-1710 Pitt-Tech Plus EP DTM Acrylic Satin.
    c. S-W: B66W1251 Pro Industrial DTM Acrylic Eg-Shel.

H. Zinc-Coated Metal: Semi-Gloss Direct to Metal (“DTM”) Acrylic Enamel Finish: 2 Coats over primer, with min. total DFT of 2.5 mils.
1. Prime Coat: Lead-free, acrylic base interior galvanized metal primer, premium grade.
    a. Moore: HP04 Ultra Spec HP Acrylic Metal Primer.
    b. PPG: 90-1908 Pitt-Tech Plus EP Acrylic Primer/Finish.
    c. S-W: B66W1151 Pro Industrial DTM Acrylic Semi-Gloss Coating.
2. First and Second Coats: DTM Acrylic Semi-Gloss Enamel. Same as for ferrous metal.

I. Painted Woodwork and Hardboard: Semi-Gloss Acrylic Enamel Finish: Two topcoats over undercoater. Provide at painted wood shelving, electrical panel boards, and as noted.
1. Prime Coat: Interior Oil Undercoat.
    a. Moore: 024 Fresh Start Multi-Purpose Interior/Exterior Oil Based Primer.
    b. PPG: 17-941NF Seal Grip Int/Ext. Alkyd Universal Primer.
    c. S-W: B49 W8820 Multi-Purpose Oil-Based Primer.
2. Prime Coat: Interior Latex Undercoat, for medium-duty, low-VOC formulation.
    a. Moore: N023 Fresh Start Multi-Purpose Latex Primer.
    b. PPG: 17-921 Seal Grip Int/Ext Acrylic Universal Primer.
    c. S-W: B28 W811 Premium Wall & Wood Primer.
3. First and Second Finish Coats: DTM Acrylic Semi-Gloss Enamel. DFT 3.5 Mils min.
    a. Moore: HP29 Ultra Spec DTM Acrylic Semi-Gloss.
    b. PPG: 90-1110 Pitt-Tech Int/Ext Satin DTM Industrial Enamel.
    c. S-W: B66W1150 Series Pro Industrial DTM Acrylic Semi-Gloss Coating.
4. First and Second Finish Coats: Premium Acrylic Semi-Gloss Enamel <150 g/L. DFT 3.5 Mils min.
    a. Moore: 551 Regal Select Semi-Gloss.
    b. PPG: 87-6 Manor Hall Interior Semi-Gloss Acrylic Latex.
    c. S-W: B31W20 ProClassic Waterborne.

J. Stained woodwork with transparent finish is specified in Division 6 Sections by woodworker.

END OF SECTION 099100

SECTION 101400
SIGNAGE

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines.

B. ADA Standards - 2010 ADA Standards for Accessible Design.

C. ICC A117.1 - Accessible and Usable Buildings and Facilities.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Pre-Fabrication Meeting: The signage contractor shall meet with representatives of the Owner to develop a Signage Schedule, including signage style and layout, individual sign locations, including locations of code required signage and wayfinding signage, and final room naming and numbering. The Architect will provide the graphics contractor with reproducible floor plan drawings for use in determining sign locations.

1.03 SUBMITTALS

A. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.

B. Signage Schedule (After Pre-Fabrication Meeting): Submit schedule with information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.

1. Submit for approval by Owner through Architect prior to fabrication.

C. Selection Samples: Where colors are not specified, submit color selection charts or chips for each type of signage.

D. Verification Samples: Submit samples, manufacturer's standard size, showing selected colors for each type of signage.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.

B. Package room and door signs in sequential order of installation, labeled by floor or building.

C. Store tape adhesive at normal room temperature.

1.05 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.

B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.01 SIGNAGE APPLICATIONS

A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.

B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
   1. Sign Type: Flat signs with engraved panel media as specified.
   2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
   3. Toilet room signage shall include pictograms and international symbol of accessibility.

2.02 PANEL SIGNAGE TYPES

A. Manufacturers:
   1. Allen Industries Architectural Signage.
   2. APCO Graphics, Inc.
   3. ASI-Modulex, Inc.
   4. Best Sign Systems, Inc.
   5. Gemini Incorporated.
   6. Innerface Sign Systems, Inc.
   7. InPro Corporation.
   8. Matthews International Corporation, Bronze Division.
   9. Mohawk Sign Systems.
   10. Nelson-Harkins Industries.
   11. Seton Identification Products.
   12. The Supersine Company.
   13. Welch Sign.
   14. Worth Higgins and Associates.
   15. Substitutions: See Section 016000 - Product Requirements.

B. Photopolymer Panel Signage: Signage media without frame.
   1. Signage Material: 0.032-inch water wash photopolymer face layer over a 0.160-inch phenolic or 0.120-inch PETG base layer.
   2. Edges: Square.
   3. Corners: Square.
   4. Wall Mounting of One-Sided Signs: Tape adhesive.
      a. For signs mounted to glass, such as at door sidelights, provide a rear cover plate so the backside of sign will not be visible through the glass.
   5. Tactile Signage: Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.

C. Aluminum Panel Signage: Fabricate of minimum 0.063-inch aluminum sheet, without frame, with baked enamel finish. Wall mount with stainless steel fasteners in each corner. Not acceptable at locations requiring tactile signage.

D. Color and Font: Unless otherwise indicated, panel signage, font, and color shall be selected from manufacturer's full range.

E. Code-Required Signage: In addition to the room signage, provide panel signage required by accessibility regulations and requirements of authorities having jurisdiction, including, but not limited to, the following:
   1. Tactile exit signs, stairway identification signs, room maximum capacity signs, elevator signs, and accessible space signs.
   2. Refer to Division 26 and Electrical Drawings for illuminated exit signs.

2.03 ACCESSORIES

A. Concealed Screws: Stainless steel, or other non-corroding metal.

B. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install neatly, with horizontal edges level.

C. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.

1. Room Signs: Mount on latch side, with a clear space of 18 inches by 18 inches beyond the door swing arc, centered on the tactile characters. At double doors, mount to the right of right-hand leaf or on nearest adjacent wall. Mount at height that is compliant with ADA Standards.

D. Protect from damage until Date of Substantial Completion; repair or replace damaged items.

END OF SECTION 101400

SECTION 102113.19
PLASTIC TOILET COMPARTMENTS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings where required.

1.03 SUBMITTALS

A. Product Data: Provide data on panel construction, hardware, and accessories.
   1. Provide data for wall anchors for attachment of wall brackets.
   2. Provide data substantiating that door latch product complies with accessibility standards.
   3. Provide data indicating NFPA 286 testing and compliance.

B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
   1. Include locations of plumbing fixtures and floor drains.
   2. Include accessible and ambulatory stalls, including stall and door clearances.

C. Selection Samples: Submit color charts indicating manufacturer's full range of colors. Color charts shall indicate which colors are NFPA 286 compliant.

D. Verification Samples: Submit manufacturer's physical samples of each selected color.

E. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods. Describe cleaning materials detrimental to finish surfaces and hardware finish.

F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide 15 year manufacturer warranty against defects in material and workmanship, excluding abuse.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Solid Plastic Toilet Compartments:
   1. ASI Accurate Partitions.
   2. ASI Global Partitions.
   3. Hadrian.
   4. General Partitions Mfg. Corp.
   5. Scranton Products.
   6. Substitutions: Section 016000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: Provide HDPE panels tested per NFPA 286 and shown to meet the following criteria:
   1. During the 40 kW exposure, flames shall not spread to the ceiling.
   2. During the 160 kW exposure:
      a. Flame shall not spread to the outer extremity of the sample on any wall or ceiling.
      b. Flashover, as defined in NFPA 286, shall not occur.
   3. The peak rate of heat release throughout the NFPA 286 test shall not exceed 800 kW.
   4. The total smoke released throughout the NFPA 286 test shall not exceed 1,000 m^2.

2.03 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.
   1. Color: As selected by Architect from manufacturer's full range of NFPA 286 compliant colors.
   2. Doors: All door widths shall be clear widths with door open at 90 degrees.
      a. Thickness: 1 inch.
      b. Door Width (Standard Stalls): 24 inch, in-swinging.
      c. Door Width (Ambulatory Stalls): 32 inch, out-swinging.
      d. Door Width (Accessible Stalls): 36 inch, out-swinging.
      e. Height: 55 inch.
   3. Panels:
      a. Thickness: 1 inch.
      b. Height: 55 inch.
   4. Pilasters:
      a. Thickness: 1 inch.
      b. Width: As required to fit space; minimum 3 inch.
   5. Urinal Partitions: Provide wall mounted type (no post/pilaster).
      a. Thickness: 1 inch.
      b. Height: 42 inches.
      c. Depth: 1'-6" minimum. Verify with depth of submitted urinal product; front of urinal partition shall extend a minimum of 6 inches beyond the outermost front lip of the urinal.

2.04 ACCESSORIES

A. Material for Hardware and Accessories: Provide stainless steel or anodized aluminum as indicated, with satin finish. Where not indicated, Contractor may provide either material at its option. Zamac is not acceptable.
   1. All hardware at out-swinging doors shall comply with accessibility regulations.

B. Pilaster Shoes: Stainless steel, satin finish, 3 inches high; concealing floor fastenings.

C. Head Rails: Extruded aluminum, anti-grip profile.
   1. Size: Manufacturer's standard size.

D. Wall and Pilaster Brackets: Natural anodized aluminum with minimum 0.125 inch wall thickness; continuous type.

E. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
   1. For attaching panels and pilasters to brackets: Through-bolts and nuts; tamper proof.

F. Hinges: Coordinate hinges with latch and keeper to provide emergency access.
   1. Continuous (Piano) Hinges (Heavy-Duty): 3-inch-wide, continuous, 0.062-inch (16 gauge) thick stainless steel piano hinge with 1/8-inch stainless steel pivot pin. Provide spring-loaded self-closing type with five (5) adjustable internal springs at accessible, barrier-free, and outswing doors, and provide gravity type with cam knuckles that can be adjusted to hold doors open at inswinging doors. Hinge length shall be a maximum of 1 inch less than door height. Provide pre-drilled hinge leaves for mounting and stainless steel through-bolts; holes at 12 inches o.c.

G. Door Hardware: Coordinate latch and keeper with hinges to provide emergency access.
   1. Door Latch (Heavy-Duty): Slide type, cast stainless steel with minimum 0.150-inch thickness slide bar, latch knob welded to slide bar.
   2. Door Strike and Keeper with Rubber Bumper (Heavy-Duty): Cast stainless steel, minimum 2.5-inch high with minimum 0.125-inch wall thickness, with integral rubber bumper. Mount on pilaster in alignment with door latch.
   3. Provide a door pull on both sides of door for accessible and ambulatory compartments, in compliance with the ADA Standards for Accessible Design.

H. Coat Hook with Rubber Bumper: One per compartment, mounted centered on inside face of door.

I. Rubber Door Bumper: Mount in upper corner on latch side of outswinging doors where door will impact wall in the open position.

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 INSTALLATION

A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.

B. Install toilet partitions with minimum 12 inch toe space clearance from bottom of partition to top of finished floor surface. Do not exceed 12-1/2 inch clearance above finished floor.

C. Install urinal partitions with bottom of partition at a height not greater than 12 inches above finished floor surface, but not lower than 11-1/2 inches above finished floor.

D. Maintain 3/8 inch to 1/2 inch space between wall and panels and between wall and end pilasters.

E. Attach panel brackets securely to walls using anchor devices.

F. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.

3.03 TOLERANCES

A. Maximum Variation From True Position: 1/4 inch.

B. Maximum Variation From Plumb: 1/8 inch.

3.04 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.

END OF SECTION 102113.19

SECTION 102800
TOILET AND BATH ACCESSORIES

PART 1 GENERAL

1.01 REFERENCE STANDARDS

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

B. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

E. ASTM C1036 - Standard Specification for Flat Glass.

F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.

G. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror.

H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

I. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

1.03 SUBMITTALS

A. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

B. Setting Drawings: For cutouts required in other work; include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.

C. Maintenance Data: For each type of accessory, to include in maintenance manual per Section 017800 - Closeout Submittals. Include list of replacement parts and service recommendations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Commercial Toilet, Shower, and Bath Accessories:
   1. American Specialties, Inc.
   2. Bobrick Washroom Equipment.
   3. Bradley Corporation.

B. Under-Lavatory Pipe Supply Covers:
   1. Plumberex Specialty Products, Inc.
   2. Truebro; IPS Corporation.

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.

B. Keys: Provide 6 master/universal keys, minimum, to Owner.

C. Stainless Steel Sheet: ASTM A666, Type 304.

D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.

E. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.

F. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.

G. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.
   1. Provide mechanical attachment of all accessories. Use of adhesive or double-side tape is not acceptable.

2.03 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.

2.04 TOILET ACCESSORIES SCHEDULE, GENERAL

A. General: The following products make reference to the designations indicated on the Toilet Accessories Schedule, Toilet Assemblies, and toilet room plans on the drawings; herein designated as "TA-x".

2.05 COMMERCIAL TOILET AND BATH ACCESSORIES

A. Grab Bars (TA-A, B, & C): 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, concealed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
      c. Finish: Satin.
      d. Length and Configuration: As indicated on drawings.
      e. Products:
         1) American Specialties, Inc.; 3700 Series.
         2) Bobrick Washroom Equipment, Inc.; B-5806 Series.
         3) Bradley Corporation; 832 Series.

B. Toilet Paper Dispenser (TA-D): Roll-in-reserve type, designed to allow automatic activation of reserve roll when needed, or manual activation by pressing release bar, surface-mounted, stainless steel unit with pivot hinge, tumbler lock.
   1. Products:
      a. American Specialties, Inc.; Model 20030.
      b. Bobrick Washroom Equipment, Inc.; Model B-4288.
      c. Bradley Corporation; Model 5402.

C. Sanitary Napkin Disposal Unit (TA-E): Stainless steel, surface-mounted, self-closing door, with full-length stainless steel piano-type hinge, removable receptacle.
   1. Products:

a. American Specialties, Inc; Model 20852.
b. Bobrick Washroom Equipment, Inc.; Model B-270 Contura.
c. Bradley Corporation; Model 4781-11.

D. Soap Dispenser (TA-F): Liquid soap dispenser, wall-mounted, surface, with stainless steel cover and vertical stainless steel tank and working parts; push type soap valve, check valve, and window gauge refill indicator, tumbler lock.
1. Minimum Capacity: 40 ounces.
2. Products:
a. American Specialties, Inc.; Model 0347.
b. Bobrick Washroom Equipment, Inc.; Model B-2111.
c. Bradley Corporation; Model 6562.

E. Mirrors (TA-G): Stainless steel framed, 1/4 inch thick annealed float glass; ASTM C1036.
1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.
2. Size: As indicated on Drawings.
3. Frame: 0.05 inch angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
4. Products:
a. American Specialties, Inc; 0600 A Series.
b. Bobrick Washroom Equipment, Inc.; Model B-290.
c. Bradley Corporation; Model 780.

F. Paper Towel Dispenser (TA-Q): Manual, roll paper type.
1. Cover: High-impact plastic; black or translucent "smoke" as standard with manufacturer.
2. Paper Discharge: Manual dispense by lever/paddle operation.
3. Capacity: 8-inch diameter roll.
4. Mounting: Surface mounted.
5. Products (Lever):
a. Bradley Corp; Model 2495.
b. Georgia-Pacific; Model 54338A.
c. Kimberly-Clark Professional; Lev-R-Matic Model 09765.

G. Paper Towel Dispenser (TA-J): Electric, roll paper type.
1. Cover: High-impact plastic; black or translucent "smoke" as standard with manufacturer.
2. Paper Discharge: Touchless automatic.
3. Capacity: 8-inch diameter roll.
4. Mounting: Surface mounted.
5. Power: Battery operated.
6. Products:
a. Bobrick Washroom Equipment, Inc; B-72974.
b. Georgia-Pacific Professional; enMotion Model 59498A.
c. Kimberly-Clark Professional; Model #48857.

H. Robe Hook (TA-T): Heavy-duty stainless steel, double-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish. Provide one centered on interior face of door of all single-user toilet rooms and one adjacent to each shower, unless otherwise indicated on Drawings; verify final mounting locations with Architect in field.

1. Products (Double-Prong):
    a. American Specialties, Inc.; Model 7345.
    b. Bobrick Washroom Equipment, Inc.; Model B-7672.
    c. Bradley Corporation; Model 9124.

2.06 UNDER-LAVATORY PIPE AND SUPPLY COVERS

A. Under-Lavatory Pipe and Supply Covers:
    1. Insulate exposed drainage piping, including hot, cold, and tempered water supplies under lavatories or sinks to comply with ADA Standards.
    2. Exterior Surfaces: Smooth non-absorbent, non-abrasive surfaces.
    3. Construction: 1/8 inch flexible PVC.
        a. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
        b. Microbial and Fungal Resistance: Comply with ASTM G21.
    4. Color: White.
    5. Fasteners: Reusable, snap-locking fasteners with no sharp or abrasive external surfaces.
    6. Products:
        a. Plumberex Specialty Products, Inc; Plumberex Trap Gear.
        b. Truebro; IPS Corporation; Lav Guard 2.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

3.02 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.

C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated on Drawings.

3.03 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION 102800

SECTION 105116
WOOD LOCKERS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

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

B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition.

C. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood.

1.02 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's published data on locker construction, sizes, fittings, and accessories.

C. Shop Drawings: Indicate locker plan layout, numbering plan, combination lock code, and key codes.

D. Samples: Submit two samples of wood veneer panel, 3 by 3 inch in size illustrating wood grain, stain color, and sheen.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least five years of documented experience.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store lockers in a dry, ventilated area until ready for installation.

1.05 FIELD CONDITIONS

A. Ambient Conditions: Maintain temperature and relative humidity within range recommended by wood locker manufacturer during and after installation of lockers.

1.06 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Provide five year manufacturer warranty for lockers, to cover workmanship, material, and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Wood Lockers:

1. Hollman, Inc; ____: www.hollman.com/#sle.
2. Ideal Products, Inc; ____: www.idealockers.com/#sle.
3. List Industries, Inc; ____: www.listindustries.com/#sle.

2.02 WOOD LOCKERS

A. Lockers: Factory assembled, made of hardwood plywood panels with mortise and tenon joints and hardwood plywood doors; fully finished inside and out; each locker capable of standing alone.

1. Species: Red oak.
2. Doors: Full overlay, covering full width and height of locker body.
3. Wood Finish: Manufacturer's standard stain and clear sealer.
4. Interior Finish: Match locker exterior wood species and finish.
5. Edge Banding: Hardwood edgebanding matching species, color, and grain of exposed wood surfaces.
6. Where locker ends or sides are exposed, finish the same as fronts or provide extra panels to match fronts.

B. Component Thicknesses:
1. Doors: 3/4 inch minimum thickness.
2. Locker Body: Tops, bottoms, sides, and shelves 3/4 inch; backs 1/2 inch; minimum.

C. Hinges: Concealed cabinetwork style hinge, minimum 120 degree opening, attached with tamperproof screws.

D. Coat Hooks: Stainless steel; attached with tamperproof screws.

E. Number Plates: Manufacturer's standard, permanently attached with adhesive; may be field installed.

F. Built-In Digital Keypad Locks:
1. Built-In Digital Keypad Lock: Battery-powered lock with alphanumeric keypad for 4-digit access code; optional access with programming, manager bypass, or user key.
a. Latch: Deadbolt.
b. Temporary or shared access with user-defined code.

2.03 MATERIALS

A. Wood-Based Materials:
1. Composite Wood Panels: Containing no urea-formaldehyde resin binders.

B. Hardwood Plywood: Veneer core; HPVA HP-1 grade as indicated, species as indicated, clear, compatible grain and color, no defects.

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.

3.02 CLEANING

A. Clean locker interior and exterior surfaces.

END OF SECTION 105116

SECTION 113013
RESIDENTIAL APPLIANCES

PART 1 GENERAL

1.01 REFERENCE STANDARDS

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

B. ICC A117.1 - Accessible and Usable Buildings and Facilities.

C. UL (DIR) - Online Certifications Directory.

1.02 SUBMITTALS

A. Product Data: Manufacturer's data indicating dimensions, capacity, and operating features of each piece of residential equipment specified.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with a service center within 50 miles of Project site capable of maintenance and emergency repairs.

B. Electric Appliances: Listed and labeled by UL (DIR) and complying with NEMA Standards (National Electrical Manufacturers Association).

C. Accessibility: Where ADA-compliant appliances are indicated, provide appliances that comply with reach ranges and operable parts requirements in compliance with ICC A117.1 and ADA Standards.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers:
   1. BOSCH Home Appliances.
   2. Fisher and Paykel.
   3. Frigidaire Home Products.
   4. GE Appliances.
   5. Jenn-Air.
   6. Maytag.
   7. Whirlpool Corp.
   8. Samsung Appliances

2.02 LAUNDRY APPLIANCES

A. Stacked Unit - Combo Washer and Dryer
   1. Clothes Washer: Front-loading; ADA-compliant.
      a. Basis-of-Design Product: Samsung Appliances; Model WH46DBH500EVA3.
   2. Size: Large capacity.
      a. Interior Size: 4.8 cubic ft.
   3. Clothes Dryer: Front Loading
      a. Interior Size: 7.8 cubic ft.
      b.

4. Controls: Solid state electronic with rotary cycle selector; front-mounted; with eletronic moisture sensing dry control.
5. Energy Usage: Provide ENERGY STAR qualified product.
6. Cycles:
   a. Washer: Include multiple cycles for normal, delicates, quick wash, whites. Include with at least 5 spin speed options and 5 water temperature options.
   b. Dryer: Include multiple cycles for normal, delicates, quick dry, and timed dry. Include with at least 5 heat selections.
   c.
7. Additional Features:
   a. Washer: Include adaptive, automatic temperature, water level, and spin controls. Include dispensers for bleach, fabric softener, and sanitizer, self-cleaning lint filter, and delay wash option.
   b. Dryer: Include automatic moisture sensor to adjust control, front-mounted lint filter, and delay dry option.
8. Ventilation: Provide ductwork sized to match outlet, in length required to vertically extend through roof. Provide gooseneck exhaust vent at roof. Coordinate with Division 7 roofing contractor for roof penetration.
9. Electrical Requirements:
   a. Washer: 120V; 60 Hz; 20 Amp.
   b. Dryer: 208/240V; 60Hz; 24 Amp
10. Finish: Painted steel, color Brushed Black.

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.

END OF SECTION 113013

SECTION 211000 - WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract apply to this Section.

1.2 SUMMARY

A. Description of Work:

1. The work includes designing and providing an automatic fire extinguishing system of required hazard for building occupancy to afford complete fire protection coverage throughout. The design, equipment, materials, installation and workmanship shall be in strict accordance with the Owners insurance underwriters requirements, the South Carolina Statewide Building Code, and the required and advisory provisions of NFPA.

2. Unless otherwise indicated piping shall not be run in spaces containing electrical equipment in the form of transformers, panel-boards, switchgear, or computer servers.
   a. Exceptions:
      1) Personal computers (PC,s)
      2) Spaces whose name does not include the term "Electrical", "Data", or "Computer"

3. Each system shall include materials, accessories and equipment necessary to provide each system complete and ready for use.

4. The design of each system shall give full consideration to blind spaces, piping, electrical equipment, ductwork, and all other construction and equipment to afford complete coverage.

5. Devices and equipment for fire protection service shall be of an approved make and type listed by the Underwriters' Laboratories, Inc., or approved by the Factory Mutual System.

6. In the publications referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears.

7. Reference to the "authority having jurisdiction" shall be interpreted to mean the Local Fire Marshal..

8. The work shall begin outside the building at a point five feet from the exterior surface of the wall at the location indicated on the drawings.

9. Calculations shall include delivering water from the point of the fire hydrant flow test through the site piping.

10. Consideration shall be given to all unheated areas such as attics, utility rooms, loading docks, outdoor storage spaces with canopies, etc., to provide freeze protection in accordance with NFPA 13. This shall include the installation of dry sprinklers or dry-pipe sprinkler systems where necessary.

1.3 SYSTEM DESCRIPTIONS

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

1.4 PERFORMANCE REQUIREMENTS

A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.

B. Fire-suppression sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 10 percent or 10 psi whichever is greater, including losses through water-service piping, valves, and backflow preventers.
2. Sprinkler Occupancy Hazard Classifications shall be as indicated on the drawings.

3. Minimum Density for Automatic-Sprinkler Piping Design:

    a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. (6.3 mL/s over 139-sq. m) area.
    b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. (9.5 mL/s over 139-sq. m) area.
    c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. (12.6 mL/s over 139-sq. m) area.

4. Maximum Protection Area per Sprinkler:

    a. Office Spaces: 225 sq. ft. (20.9 sq. m).
    b. Storage Areas: 130 sq. ft. (12.1 sq. m).
    c. Mechanical Equipment Rooms: 130 sq. ft. (12.1 sq. m).
    d. Electrical Equipment Rooms: 130 sq. ft. (12.1 sq. m).
    e. Other Areas: According to NFPA 13 recommendations, unless otherwise indicated.

5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13, unless otherwise indicated:

    a. Light-Hazard Occupancies: 100 gpm (6.3 L/s) for 30 minutes.
    b. Ordinary-Hazard Occupancies: 250 gpm (15.75 L/s) for 60 to 90 minutes.

C. Seismic Performance: Fire-suppression piping shall be capable of withstanding the effects of earthquake motions determined according to ASCE 7-02, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."

D. Seismic Performance: Fire-suppression piping shall be capable of withstanding the effects of earthquake motions determined according to NFPA 13

1.5 SUBMITTALS

A. Product Data: For the following:

1. Piping materials, including flexible connections and sprinkler specialty fittings.
2. Pipe hangers, supports and seismic restraints.
3. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.

B. Fire-hydrant flow test report.

Approved Sprinkler Piping Shop Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations. Diagram power, signal, and control wiring.

1. Include shop drawings indicating location of all sprinkler heads and all other construction that penetrates ceilings, including light fixtures, HVAC equipment, speakers, fire alarm devices, partition assemblies, etc.
2. Sprinklers shall be referred to on drawings, submittals and other documentation, by the sprinkler identification or Model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.

C. Welding certificates.

D. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.6 CLOSEOUT SUBMITTALS

1. 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"

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering

responsibility. A Professional Engineer registered in the state where the project is constructed shall stamp and seal the Shop Drawings.

B. Flow test:

1. Bid shall be based on the indicated fire-hydrant flow and pressure.

2. Design calculations shall be based on the results of confirming fire-hydrant flow test performed or caused to be performed by the contractor.

C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

D. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, 2019 edition, "Installation of Sprinkler Systems."

1.8 COORDINATION

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

B. Relocate piping to clear the path of ductwork.

C. Relocate piping to clear the path of conduit.

D. Relocate piping to clear the path of cable tray.

E. Coordination for exposed sprinkler piping:
1. The intent for this coordination is to reduce the visibility of exposed sprinkler piping within exposed spaces. The shop drawings shall identity exposed areas to eliminate exposed sprinkler piping as much as possible.
2. For clear stories: Coordinate Sprinkler piping to avoid piping be installed in front of glazing assemblies. Where routing shall be in between windows or in front of mullions for a neat exposed appearance approved by Architect.
3. For roof height elevation changes in exposed areas: Limit Sprinkler piping to 1 or 2 locations within a single open space to reduce visibility of vertical piping. Sprinkler mains shall not be routed in exposed areas unless required. If required the main locations shall be coordinated with Architect.
4. Where vertical exposed piping occurs the piping shall be installed along the wall and in the corner to reduce visibility.

1.9 SPRINKLER CABINET(S) AND SPARE SPRINLKERS

A. Provide finished, wall-mounted, steel sprinkler cabinet with hinged cover.

B. Provide space for minimum of six spare sprinklers and sprinkler wrench.

C. Provide number of sprinklers required by NFPA 13.

PART 2 - PRODUCTS

2.1 STEEL PIPE AND FITTINGS

A. Threaded-End, Schedule 40 Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed threaded ends.

1. Cast-Iron Threaded Flanges: ASME B16.1.
2. Malleable-Iron Threaded Fittings: ASME B16.3.
3. Gray-Iron Threaded Fittings: ASME B16.4.
4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method. Steel Threaded Couplings: ASTM A 865.FLEXIBLE CONNECTORS

B. Flexible connectors shall have materials suitable for system fluid. Include 175-psig minimum working-pressure rating and ends according to the following:

1. NPS 2 and Smaller: grooved.
2. NPS 2-1/2 (DN 65) and Larger: grooved.
3. Option for NPS 2-1/2 and Larger: Grooved for use with grooved-end-pipe couplings.

C. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.

2.2 SPRINKLER SPECIALTY FITTINGS

A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig (1200-kPa) minimum working-pressure rating, and made of materials compatible with piping.

B. Outlet Specialty Fittings:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company.
2. Mechanical-T and -Cross Fittings: UL 213, ductile-iron housing with gaskets, bolts and nuts, and threaded, locking-lug, or grooved outlets. Basis of design Victaulic style 920/920N and style 922.
3. Snap-On and Strapless Outlet Fittings: UL 213, ductile-iron housing or casting with gasket and threaded outlet. Basis of design Victaulic style 923.

2.3 GENERAL-DUTY VALVES

A. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company.

B. Ball Valves NPS 2 and Smaller: MSS SP-110, 2-piece copper-alloy body with chrome-plated brass ball, 600-psig minimum CWP rating, blowout-proof stem, and threaded ends.

C. Check Valves NPS 2 and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.

D. Globe Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, nonmetallic disc, and threaded ends.

2.4 SPRINKLERS

A. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating. Basis of design Victaulic/Globe.

B. Automatic Sprinklers: UL-Listed with quick response glass bulb type heat-responsive element complying with the following:

1. UL 199, for nonresidential applications.

C. Wrenches shall be provided by the sprinkler manufacturer that directly engage the hex-shaped wrench boss integrally cast in the sprinkler body.

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

1. Brass upright sprinklers.
2. Concealed pendent sprinklers, including cover plate.
3. Pendent sprinklers.
4. Quick-response sprinklers.
5. Recessed sprinklers, including escutcheon.

E. Sprinkler Escutcheons and finishes: Materials, types, and finishes shall match existing sprinklers installed throughout system.

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

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in Part 1 "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 PIPING APPLICATIONS, GENERAL

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

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

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

3.3 SPRINKLER SYSTEM PIPING APPLICATIONS

A. Standard-Pressure, Wet-Pipe Sprinkler System, 175-psig (1200-kPa) Maximum Working Pressure:

1. Sprinkler-Piping Fitting Option: Specialty sprinkler fittings, NPS 2 and smaller, including mechanical-T and -cross fittings, may be used downstream from sprinkler zone valves.
2. Sprinkler Piping NPS 2" and smaller use any of the following:
   a. Threaded-end, black, schedule 40 steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
   b. Plain-end, black, schedule 40 steel pipe; steel welding fittings; and welded joints.
   c. Grooved-end, black, schedule 40 steel pipe with square-cut- or roll-grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

3.4 JOINT CONSTRUCTION

A. Refer to Division 21 Section "Common Work Results for Fire Suppression" for basic piping joint construction.

B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 (DN 200) with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gage and comply with ASME B1.20.1.

3.5 WATER-SUPPLY CONNECTION

A. Connect fire-suppression piping to building's interior water distribution piping. Refer to Division 22 Section "Domestic Water Piping" for interior piping.

3.6 PIPING INSTALLATION

A. Refer to Division 21 Section "Common Work Results for Fire Suppression" for basic piping installation.

B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Piping shall be exposed in spaces without ceilings only if supplying sprinklers in the same space.

2. The only piping allows over rooms containing electrical equipment in the form of , transformers, panelboards, switchgear, or computer servers shall be pipes serving sprinklers within each electrical equipment space.
   a. Exception:
      1) Generator or transformer rooms separated from the remainder of the building by walls and floor/ceiling or roof/ceiling assemblies having a fire-resistance rating of not less than two hours shall not require sprinkler coverage provided that such rooms are protected with an approved automatic fire detection system.

3. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

C. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.

E. Install sprinkler piping with drains for complete system drainage.

F. Hangers and Supports: Comply with NFPA 13 and "Hanger and Supports for Fire-Suppression Piping" for hanger materials.
   1. Install sprinkler system piping according to NFPA 13.

G. Earthquake Protection: Install piping according to ASCE 7-02, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."

H. Earthquake Protection: Install piping according to NFPA 13 to protect from earthquake damage.

I. Fill wet-pipe sprinkler system piping with water.

3.7 SPRINKLER APPLICATIONS

A. Drawings indicate sprinkler types to be used. Where specific types are not indicated, use the following sprinkler types:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Recessed pendent sprinklers unless otherwise indicated then concealed sprinklers as indicated.
3. Spaces Subject to Freezing: Upright, dry pendent, dry sidewall sprinklers as indicated.
4. Sprinkler Finishes:

   a. Upright, Pendent, and Sidewall Sprinklers: Shall match existing sprinklers installed through out existing building.

3.8 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings centered both ways in acoustical ceiling panels and tiles.

B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space wherever possible. Otherwise, use , antifreeze sprinkler systems, or dry-pipe systems.

3.9 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Connect water-supply piping to fire-suppression piping. Include backflow preventer between potable-water piping and fire-suppression piping. Refer to Division 22 Section "Domestic Water Piping Specialties" for backflow preventers.

D. Electrical Connections: Power wiring is specified in Division 26.

E. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.10 LABELING AND IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and "Common Work Results for Fire-Suppression" for piping identifications.

3.11 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.

B. Report test results promptly and in writing to Architect and authorities having jurisdiction.

3.12 CLEANING AND PROTECTION

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

C. Protect sprinklers from damage until Substantial Completion.

D. Protect the exterior of the building when operating drains and test connections that discharge to the exterior.

E. Dirt and stains on any surfaces resulting from the work of this section of the specifications shall be cleaned and removed under this section of the specifications.

3.13 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves. Refer to Division 01 Section "Closeout Procedures".

END OF SECTION 211000

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.

4. Escutcheons.

1.4 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.6 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.7 INTENT OF CONTRACT DOCUMENTS

A. Plumbing drawings are diagrammatic, indicating general locations and arrangements of pipe, and equipment. Not necessarily indicating all offsets, conditions, and appurtenances required to provide clearances for maximum practical accessibility to perform maintenance.

B. Coordinate work in order to achieve proper operation and to provide a maintainable installed condition.

C. Notify the Architect's representative immediately of conditions which do not comply or will not produce this result.

D. Indicated configurations were used to size pipes, pumps, expansion tanks and other devices. Install piping and equipment generally as indicated. Minor deviations are permitted in the course of necessary coordination. Major changes shall be submitted for approval by the Architect's representative. Additional fittings and offsets not shown on the drawings are expected, anticipated by the design, and shall be provided. If more than 5% of the indicated number of fittings are required or if one change in direction is within six inches of another change in direction and this "Z" shape is not indicated notify the Architect's representative immediately. Provide necessary additional fittings and offsets. Changes in pipe size shall be made only with written approval from the Architect's representative.

1.8 INSTALLED EXTRA PIPING AND EQUIPMENT

A. Each of these items shall include 30' of ½" domestic water piping, fittings, valves, insulation, and accessories, etc… As needed throughout the project, the A/E or Owner will direct the Plumbing Contractor (PC) where these items are to be installed.
   1. There shall be a line item on the plumbing schedule of values titled "Extra Piping and Equipment".
   2. At project completion, a credit shall be given to the Owner for all unused extra piping and equipment. It shall be the Plumbing Contractor's responsibility to keep track and record of this work.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Refer to other Division 22 piping sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

A. Refer to individual Division 22 piping sections for joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions inside & outside pipe and:

   1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is otherwise indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8-inch-thick, unless otherwise indicated, and full-face or ring type, unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free (95% Tin, 5% Antimony) alloy. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

E. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

F. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

2.3 MECHANICAL GROOVED JOINT COUPLINGS

A. Manufacturer: Victaulic

B. Description: Pipe joint consisting of a grooved pipe, EPDM gasket, steel housing, 2 bolts and 2 nuts.

C. Gasket Material: Grade "E" EPDM suitable for use up to 250 degrees F.

D. Housing: Carbon steel

2.4 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150 or 300 psig working pressure, as required to suit system pressures.

1. Available Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.

c. Epco Sales, Inc.
d. Watts Industries, Inc.; Water Products Div.

D. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Available Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Separate companion flanges and steel bolts and nuts shall have 150- or300-psig minimum working pressure where required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Available Manufacturers:

a. Calpico, Inc.
b. Lochinvar Corp.

2.5 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PE: Reusable, PE, tapered-cup-shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated.

E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.7 GROUT

A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

A. Refer to Division 2 Sections "Site and Selective Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Equipment to Be Removed: Remove equipment and associated piping back to main unless otherwise indicated. Cap services.
4. Equipment to Be Removed and Reinstalled: Disconnect and cap services. Remove, clean, and store equipment. When appropriate, reinstall, reconnect, and make equipment operational.
5. Equipment to Be Removed and Salvaged: Remove equipment and associated piping back to main unless otherwise indicated. Cap services. Remove equipment, clean, and store as directed (May be off-site). Make available to owner at time of the owner's choosing.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following and Division 22 Sections specifying piping systems.

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 the minimum slopes required by authorities having jurisdiction unless otherwise indicated.

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 escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. Exposed, Interior Installations/Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
2. Exposed, Interior Installations/Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish and set-screw.
3. Exposed, Interior Installations/Insulated Piping: One-piece, cast-brass type with polished chrome-plated finish.
4. Exposed, Interior Installations/Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with finish to match surrounding surfaces.
5. Exposed, Interior Installations/Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with finish to match surrounding surfaces.
6. Exposed, Interior Installations/Piping in Unfinished Service Spaces: None, provide sealant.
7. Exposed, Interior Installations/Piping in Equipment Rooms: None, provide sealant.
8. Exposed, Interior Installations/Piping at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces: None - provide sealant and sleeve extending 2" above floor to prevent liquid leaking to floor below

L. Sleeves are not required for core-drilled holes.
   1. Exception: Exposed, Interior Installations at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces.

M. Permanent sleeves are not required for holes formed by removable PE sleeves.
   1. Exception: Exposed, Interior Installations at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces.

N. Install sleeves for pipes passing through walls, floors, or roofs.

   1. Cut sleeves to length for mounting flush with both surfaces.

      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring.

   2. Install sleeves as walls and slabs are constructed.

      a. PVC Pipe Sleeves: Permitted for pipes smaller than NPS 6 except aboveground, exterior-walls.
      b. Steel Sheet Sleeves: Permitted for pipes NPS 6 and larger, penetrating gypsum-board partitions except aboveground, exterior-walls.

      c. Stack Sleeve Fittings: For pipes penetrating floors. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor. Seal space outside sleeve fittings with grout.

   3. Except for penetrations where mechanical sleeve seals are used, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants".

O. Aboveground Exterior Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for annular clear space required by the mechanical sleeve seal manufacturer between pipe and sleeve for installing mechanical sleeve seals.

   1. Install steel pipe for sleeves smaller than 6 inches in diameter.
   2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
   3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
   4. Sleeves from an approved sleeve seal manufacturer shall be acceptable.

P. Underground Exterior Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for annular clear space required by the mechanical sleeve seal manufacturer between pipe and sleeve for installing mechanical sleeve seals.

Q. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Section "Penetration Firestopping" for materials.

S. Verify final equipment locations for roughing-in.

T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Non-pressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Non-pressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

N. Mechanical Joints: Prepare pipe ends and fittings, apply coupling, and join according to joint manufacturer's written instructions.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping 2" and smaller, one adjacent to each valve and at final connections to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2" and larger, adjacent to final connections to each piece of equipment.
3. Install dielectric unions or flanges for connections of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING

A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 HOUSEKEEPING PADS AND EQUIPMENT PADS

A. Housekeeping pads and equipment pads: Anchor equipment to concrete according to equipment manufacturer's written instructions and according to seismic codes at project location.

1. Construct concrete pads in accordance with drawing details.
2. Details may be found on structural drawings. If details are not provided comply with the following:
    a. Housekeeping pads inside the building shall be 4" thick and 6" larger all around than supported equipment. Provide a 1" chamfer on all edges.
    b. If details are not provided, equipment pads outside the building shall be 8" thick with a 24" deep 12" wide turndown (footing) all around the outside edge of the pad. Provide welded wire mesh reinforcement. Pad shall be 12" larger all around than supported equipment.
    c. Install dowel rods to connect housekeeping pad to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the pad. Provide a 1" chamfer on all edges.
    d. Install epoxy-coated anchor bolts. For equipment on housekeeping pads bolts shall extend through housekeeping pad, and anchor into structural concrete floor.
    e. Place and secure anchor bolts using supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions for placement.
    f. Install anchor bolts to elevations required for proper attachment to supported equipment.
    g. Install anchor bolts according to anchor bolt manufacturer's written instructions.
    h. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Section "Cast-in-Place Concrete".

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.9 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.10 EXCAVATION AND BACKFILL

A. Excavation and backfill shall be as indicated in Division 1 specifications and on the drawings. If excavation and backfill is not otherwise indicated the following shall apply:
   1. Excavate trenches to indicated gradients, lines, depths, and elevations.
      a. Beyond the building perimeter, excavate trenches to allow installation of top of pipe below frost line.
   2. Excavate trenches to uniform widths to provide twelve inches clear on each side of pipe. Excavate trench walls vertically from trench bottom.
   3. Trench Bottoms: Excavate trench bottoms to provide flat surface. Place and compact six inches of sand. Excavate and shape sand to provide uniform bearing and support of pipes. Shape sand to provide continuous support for bells, joints, fittings, and barrels of pipes. Sand shall be free of projecting stones and sharp objects.
   4. Backfill and hand tamp to 95% proctor to six inches above the top of the pipe.
   5. Backfill and machine tamp the remainder of the trench to 95% proctor in twelve inch lifts.

END OF SECTION 220500

SECTION 220513 – MOTORS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

A. Manufacturer's catalog and efficiency data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.4 COORDINATION

A. Equip all motors with overload protection.

1. Locate overload protection near the motor.
2. Overload protection:
    a. Locate between the circuit breaker/fuse provided under Division 26 and the motor windings.
    b. Comply with one of the following:
        1) Locate in motor by motor manufacturer. (Design Standard)
        2) Locate separate overload device near motor.
        3) Locate in, or with, disconnect switch by equipment manufacturer. Provision of such switch shall not modify, change, or eliminate Division 26 requirements. Provide indicated disconnecting means.

B. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:

C. Compatible with controller.

D. Matched to torque and horsepower requirements of the load.

E. Matched to ratings and characteristics of supply circuit and required control sequence.

F. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.

G. Belt tension must be wrench and socket adjustable.

H. Belt tensioning device must accommodate adjustable sheaves.

PART 2 - PRODUCTS

2.1 MOTOR REQUIREMENTS

A. Motor requirements apply except as follows:

B. Ratings, performance, or characteristics for a motor are specified in another Section or are scheduled on the drawings.

C. Motor manufacturer requires ratings, performance, or characteristics, other than those specified to meet indicated performance.

2.2 MOTOR CHARACTERISTICS

A. Frequency Rating: 60 Hz.

B. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.

C. Duty: Continuous at 105 deg F and 3300 feet above sea level.

D. Capacity and Torque sufficient to:

1. Start, accelerate, and operate connected load.
2. Maintain designated speeds.
3. Operate at installed altitude and environment.
4. Operate with indicated operating sequence.
5. Operate without exceeding nameplate ratings.
6. Operate without utilizing service factor.

E. Enclosure: Open drip-proof unless otherwise indicated.

F. Minimum Service Factor: 1.15 unless otherwise indicated.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Premium efficiency motors shall meet the following full load efficiency:

HP	ODP			TEFC		
	6 Pole	4 Pole	2 Pole	6 Pole	4 Pole	2 Pole
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7
40	94.1	94.1	92.4	94.1	94.1	92.4
50	94.1	94.5	93.0	94.1	94.5	93.0
60	94.5	95.0	93.6	94.5	95.0	93.6
75	94.5	95.0	93.6	94.5	95.4	93.6
100	95.0	95.4	93.6	95.0	95.4	94.1
125	95.0	95.4	94.1	95.0	95.4	95.0

	95.4	95.8	94.1	95.8	95.8	95.0

C. Efficiency: Premium

D. Stator: Copper windings, unless otherwise indicated.

E. Rotor: Squirrel cage, unless otherwise indicated.

F. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating, unless otherwise indicated.

H. Insulation: Class F, unless otherwise indicated.

I. Code Letter Designation: NEMA starting Code F or G.

J. Enclosure: Cast iron.

K. Finish: Gray enamel.

L. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

M. Source Quality Control: Perform the following tests on each motor according to NEMA MG 1:

N. Measure winding resistance.

O. Read no-load current and speed at rated voltage and frequency.

P. Measure locked rotor current at rated frequency.

Q. Perform high-potential test.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Perform the following:

1. Run each motor with its controller at load.
2. Demonstrate correct rotation, alignment, and speed.
3. Test interlocks and control features for proper operation.
4. Verify that current in each phase is within nameplate rating.
5. Verify RPM is in accordance with nameplate.
6. Where a generator is provided, run each motor on the generator with its controller and load. Demonstrate correct rotation, alignment, and speed.

3.2 ADJUSTING

A. Align motors, bases, and shafts.

3.3 CLEANING

A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

END OF SECTION 220513

SECTION 220523 – GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

A. The following are standard abbreviations for valves:
   1. CWP: Cold working pressure.
   2. EPDM: Ethylene-propylene-diene terpolymer rubber.
   3. MPTFE: Modified polytetrafluoroethylene plastic.
   4. NBR: Acrylonitrile-butadiene rubber.
   5. PTFE: Polytetrafluoroethylene plastic.
   6. RPTFE: Reinforced polytetrafluoroethylene plastic.
   7. SWP: Steam working pressure.
   8. TFE: Tetrafluoroethylene plastic.
   9. WOG: Water Oil Gas.

1.3 SUBMITTALS

A. Product Data: For each type of valve proposed. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include proposed specialties and accessories.

1.4 QUALITY ASSURANCE

A. ASME Compliance: ASME B31.1 for power piping valves and ASME B31.9 for building services piping valves.
   1. Exceptions: Domestic hot- and cold-water valves unless referenced.

B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

C. NSF Compliance:
   1. NSF 61 for valve materials for potable-water service.
   2. NSF 372 for Lead content requirements in drinking water system components.

1.5 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 ball valves open to minimize exposure of functional surfaces.
4. Set butterfly valves closed or slightly open.
5. Block check valves in either closed or open position.

B. Use the following precautions during storage:
1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 VALVES, GENERAL

A. Refer to Part 3 "Valve Applications" Article for applications of valves.

B. Bronze & Brass: Shall be dezincification resistant. (Zinc content shall be less than 15%)

C. Bronze Valves: 2" and smaller with threaded or soldered ends, unless otherwise indicated.

D. Ferrous Valves: 2-1/2" and larger with flanged ends, unless otherwise indicated.

E. Valve Pressure and Temperature Ratings: Not less than indicated for system pressure and temperature.

F. Valve Sizes: Same as the larger of the upstream or downstream pipe, unless otherwise indicated.

G. Valve Actuators:
1. As indicated in other Part 2 articles.
2. Where indicated, provide a chain actuator.
3. Chain Actuator: For attachment to valves of size and mounting height indicated.
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.

H. Extended Valve Stems: Provide on insulated valves.

I. Valve Flanges: Provide ASME B16.1 for cast-iron valves, ASME B16.5 for steel, and ASME B16.24 for bronze.

J. Valve Grooved Ends: AWWA C606.

K. Threaded: With threads according to ASME B1.20.1.

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

2.2 COPPER-ALLOY BALL VALVES

A. Two-Piece, Copper-Alloy Ball Valves (Full Port) (1/4" to 2-1/2"):
1. Conbraco Industries-Apollo 77CLF series with stainless steel ball & stem (Un-insulated piping)
2. Conbraco Industries-Apollo 77CLF series with stainless steel ball & stem. Provide 2 ¼" stem extension (Insulated piping)
3. Other Manufacturers:
   a. Milwaukee
   b. Watts
   c. Nibco
4. Handle Nut: Zinc plated steel or 300 series stainless steel.
5. Handle: Zinc plated steel, clear chromate plastic, or vinyl coated.
6. Threaded Pack Gland: Brass ASTM B-16
7. Packing: MPTFE or TFE
8. Stem (Blowout Proof): ASTM A-276 type 316 stainless steel. Provide 2 ¼" stem extension for Insulated piping.
9. Thrust Washer: MPTFE or RPTFE
10. Ball: Full-port, ASTM A-276 Type 316 stainless steel.
11. Seats: MPTFE or Reinforced TFE (RPTFE)
12. Body: Bronze ASTM B-584 for solder or threaded connection.
13. Body End Piece: Bronze ASTM B-584 for solder or threaded connection.
14. Rating: 150 psig saturated steam, 600 psig non-shock cold water, oil, and gas.
15. Conform To: MSS SP-110

B. Two-Piece, Bronze Ball Valves UL listed for shut-off gas service (Up to 2 ½"):
1. Conbraco Industries-Apollo 80-100 series (Un-insulated piping).
2. Conbraco Industries-Apollo 80-100 series with stainless steel ball & stem. Provide 2 ¼" stem extension (Insulated piping)
3. Other Manufacturers:
   a. Milwaukee
   b. Watts
   c. Nibco
4. Handle Nut: Zinc plated steel or 300 series stainless steel.
5. Handle: Zinc plated steel, clear chromate plastic, or vinyl coated.
6. Threaded Pack Gland: Brass ASTM B-16
7. Packing: MPTFE or TFE
8. Stem (Blowout Proof): ASTM A-276 type 316 stainless steel. Provide 2 ¼" stem extension for Insulated piping.
9. Thrust Washer: MPTFE or RPTFE
10. Ball: Brass ASTM B-16, chrome plated.
11. Seats: MPTFE or Reinforced TFE (RPTFE)
12. Body: Bronze ASTM B-584 for threaded connection.
13. Body End Piece: Bronze ASTM B-584 for threaded connection.
14. Rating: 150 psig saturated steam, 250 psi gas, vacuum service to 29".
15. Conform To: MSS SP-110

2.3 LARGE GAS BALL VALVES (ABOVE 2 ½" to 10"):

A. Carbon Steel ANSI class 150, flanged, standard port ball valve with stainless steel ball and stem.
   1. Conbraco Industries-Apollo 88A-140 series
   2. Other Manufacturers:
      a. Milwaukee
      b. Watts
      c. Nibco
   3. Provide gear operator with oversized hand wheel.
   4. Packing Gland: ASTM A108 Type 1215
   5. Packing: RPTFE or TFE
   6. Stem (Blowout Proof): ASTM A108 Type 1215
   7. Ball: Standard-port, ASTM A-276 Type 316 stainless steel solid ball.
   8. Seats: RPTFE
   9. Thrust Washer: RPTFE.
   10. Body: Carbon steel ASTM A216 WCB.
   11. Body Nut: ASTM A194, grade 2H.
   12. UL (YRPV): Listed for gas shut-off service.
   13. Rating: 150 psig saturated steam

2.4 FERROUS-ALLOY BUTTERFLY VALVES

A. General: Butterfly valves shall provide bi-directional bubble tight dead end service without a downstream flange.

B. Wafer-lug type butterfly valves:
   1. Conbraco Industries-Apollo 141(wafer)/143(lug)
   2. Other Manufacturers:
      a. Stockham
      b. Demco
      c. Nibco
   3. Shaft: ASTM A-582 Type 416 Stainless steel single piece through shaft.
   4. Collar Bushing: ASTM B-124 Brass or PTFE.
   5. Stem Seal: EPDM OR Buna-N Rubber
   6. Body Seal: EPDM Rubber
   7. Upper Bushing: CDA 122 Copper or PTFE
   8. Liner: EPDM Rubber
   9. Disc: ASTM B-148 alloy 954/955 aluminum bronze.
   10. Lower Bushing: CDA 122 copper or PTFE.
   11. Body Wafer: ASTM A-536 Ductile Iron or ASTM A-126 CL. B cast iron.
   12. Body Lug: ASTM A-536 Ductile Iron or ASTM A-126 CL. B cast iron.
   13. Ratings:
      a. 2" through 12" 200 psig CWP.
      b. 14" through 24" 150 psig CWP.
   14. Conform To: MSS SP-67, MSS SP-25, API-609
   15. Operator:
      a. Valves up to and including 6": Lever-lock operator.

b. Valves 8" and larger: Self locking worm gear operator equipped with adjustable stops at open and shut positions.

C. Grooved-End 300 psig butterfly valves:
1. Conbraco Industries-Apollo SJ-900N/SJ-900N-L
2. Other Manufacturers:
a. Victaulic
b. Nibco
3. Upper Stem: ASTM A-582 Type 416 Stainless steel.
4. Upper Bearing: Split metal.
5. O-Ring: EPDM
6. Body: ASTM A-395 ductile iron with polyimide coating.
7. Disc: ASTM A-395 ductile iron with EPDM encapsulation.
8. Lower Bearing: Split metal.
9. Dust Plug: PVC
10. Rating: 300 psig CWP.
11. Conform To: MSS SP-67
12. Operator:
a. Valves up to and including 6": Lever-lock operator.
b. Valves 8" and larger: Self locking worm gear operator equipped with adjustable stops at open and shut positions.

D. Flanged 200 psig butterfly valves:
1. Conbraco Industries-Apollo SJ-200
2. Other Manufacturers:
a. Nibco
3. Upper Stem: ASTM A-582 Type 416 Stainless steel.
4. Upper Bushing: TFE over porous bronze, steel backed.
5. O-Ring: EPDM
6. Body: ASTM A-126 Class B cast iron with polyimide coating.
7. Disc: ASTM A-395 ductile iron with EPDM encapsulation.
8. Lower Bushing: TFE over porous bronze, steel backed.
9. Lower Stem: ASTM A-582 Type 416 Stainless steel.
10. Dust Plug: PVC
11. Rating: 200 psig CWP.
12. Conform To: MSS SP-67 and MSS SP-25
13. Operator:
a. Valves up to and including 6": Lever-lock operator.
b. Valves 8" and larger: Self locking worm gear operator equipped with adjustable stops at open and shut positions.

E. Flanged 200 psig butterfly valves for Gas Service:
1. NIBCO Model FC-2765-0
2. Upper Stem: ASTM A-582 Type 416 Stainless steel.
3. Upper Bushing: TFE over porous bronze, steel backed.
4. O-Ring: EPDM
5. Body: ASTM A-126 Class B cast iron with polyimide coating.
6. Disc: ASTM A-395 ductile iron with EPDM encapsulation.
7. Lower Bushing: TFE over porous bronze, steel backed.
8. Lower Stem: ASTM A-582 Type 416 Stainless steel.

9. Dust Plug: PVC
10. Rating: 200 psig CWP.
11. Conform To: MSS SP-67 and MSS SP-25
12. Operator:
    a. Valves up to and including 6": Lever-lock operator.
    b. Valves 8" and larger: Self locking worm gear operator equipped with adjustable stops at open and shut positions.

2.5 BRONZE CHECK VALVES

A. Bronze, Horizontal Swing Check Valves:
1. Conbraco Industries-Apollo 161S/T
2. Other Manufacturers:
    a. Milwaukee
    b. Stockham
    c. Nibco
3. Bonnet: ASTM B-62 bronze.
4. Body: ASTM B-62 bronze.
5. Hinge Pin: ASTM B-140 alloy C31400 bronze, or B-134 alloy C23000 bronze.
6. Disc Hanger:
    a. Sizes ¼" thru ¾": Type 304 stainless steel.
    b. Sizes 1" and larger: ASTM B-62 bronze.
7. Hanger Nut: ASTM B-16 bronze.
8. Disc Holder: ASTM B-62 bronze.
9. Seat Disc:
    a. Water and Other Heat Transfer Fluids: ASTM B-62 bronze.
    b. Steam: TFE
10. Seat Disc Nut: ASTM B-16 or B-62 bronze.
11. Hinge Pin Plug: ASTM B-140 alloy C31600 bronze.
12. Seat Disc Washer (When Provided): ASTM B-98 alloy C65500 or B-103 bronze.
13. Rating: 125 psig SWP and 200 psig CWP.
14. Conform To: MSS SP-80

B. Bronze, Inline Spring Loaded Check Valves:
1. Conbraco Industries-Apollo 61-100 series
2. Other Manufacturers:
    a. Milwaukee
    b. Stockham
    c. Nibco
3. Body: ASTM B-584 alloy C84400 bronze.
4. Retainer/Stem: ASTM B16 brass or ASTM A-582 alloy C30300 stainless steel.
5. Ball Check: RPTFE or
6. Disc Holder 316 Stainless steel
    a. Disc:
        1) Water, Oil, Gas: Buna-N
        2) Steam: TFE
    b. Seat Screw: ASTM A-276 alloy S43000 stainless steel.
    c. Body End: ASTM B-584 alloy C84400 bronze.
    d. Rating: 125 psig SWP and 250 psig CWP.

7. Guide: ASTM B16 Brass
8. Spring: Type 316 stainless steel.
9. Rating: 125 psig SWP and 400 psig WOG.

2.6 IRON BODY CHECK VALVES

A. Iron Body, Horizontal Swing Check Valves:
   1. Conbraco Industries-Apollo 910F
   2. Other Manufacturers:
      a. Milwaukee
      b. Stockham
      c. Nibco
   3. Body Bolt: ASTM A-307 steel.
   4. Bonnet: ASTM A-126 class B cast iron.
   5. Body Gasket: Synthetic Fibers.
   6. Body Nut: ASTM A-307 steel
   7. Side Plug: ASTM B-16 alloy C36000 Brass.
   8. Hanger Pin: ASTM B-16 alloy C36000 Brass.
   9. Hanger: ASTM B-584 alloy C84400 cast bronze.
   10. Disc: ASTM B-584 alloy C84400 cast bronze or ASTM A-536 ductile iron w/bronze face ring.
   11. Seat Ring: ASTM B-584 alloy C84400 cast bronze.
   12. Disc Nut: ASTM B-16 alloy C36000.
   13. Body: ASTM A-126 class B cast iron.
   14. Disc Bolt: ASTM B-16 alloy C36000 Brass.
   15. Disc Plate: ASTM A-126 class B cast iron.
   16. Disc Cage: ASTM A-126 class B cast iron.
   17. Rating: 125 psig SWP and 200 psig CWP.
   18. Conform To: MSS SP-71 Type 1.

B. Grooved-End, Ductile-Iron Spring Assisted Check Valves: Apollo SJ-900N with EPDM disc seal.

C. Spring Actuated Silent Check Valves:
   1. NIBCO Model F-910
   2. Other Manufacturers:
      a. Milwaukee
      b. Stockham
   3. Body: ASTM A48 class 35 cast iron.
   4. Seat: ASTM B-584 alloy C83600 (B) bronze.
   5. Disc: ASTM B-584 alloy C83600 bronze.
   6. Spring: Type 302 ASTM A313 stainless steel.
   7. Bushing:
      a. 6" and Smaller: ASTM B-16 brass
      b. 8" and Larger: ASTM B-584 alloy C83600 bronze.
   8. Set Screws: Type 304 ASTM A-276 stainless steel.
   9. Rating: 200 psig CWP.
   10. Conform To: MIL-V-18436F

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully-open to fully-closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chainwheels on operators for ball and butterfly valves 4" and larger and more than 96 inches above finished floor. Extend chains to 60 inches above finished floor.

F. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
   3. Lift Check Valves: With stem upright and plumb.

G. Shutoff valves shall be provided and located on each floor, on takeoffs from all vertical risers, branch lines from the mains, and at the branch connections to each fixture.

3.3 ADJUSTING

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

3.4 VALVE APPLICATIONS

A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball or butterfly valves.
   2. Throttling Service: Ball or butterfly valves.
   3. Pump Discharge: Spring-loaded, lift-disc check valves and ball or butterfly valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

C. Domestic Water Piping: Use the following types of valves:
   1. Valves, NPS 2" and Smaller: Two-Piece, Copper-Alloy Ball Valves (Full Port).
   2. Valves, NPS 2-1/2" and 3":
      a. Two-piece or three-piece, Copper-Alloy Ball Valves (Full Port).
      b. Wafer-Lug, grooved-end, or flanged butterfly valves.
   3. Valves, NPS 4" and Larger: Wafer-Lug, grooved-end, or flanged butterfly valves.
   4. Pump Discharge Check Valves (Horizontal or Vertical), NPS 2" and Smaller: Bronze, Inline Lift Check Valves.
   5. Horizontal Check Valves, NPS 2" and Smaller: Bronze, Horizontal Swing Check Valves.
   6. Vertical Check Valves, NPS 2" and Smaller: Bronze, Inline Lift Check Valves.
   7. Pump Discharge Check Valves (Horizontal or Vertical), NPS 2-1/2" and Larger: Grooved-End, Ductile-Iron Spring Assisted Check Valves or Spring Actuated Silent Check Valves.
   8. Horizontal Check Valves, NPS 2-1/2" and Larger: Bronze, Horizontal Swing Check Valves.
   9. Vertical Check Valves, NPS 2-1/2" and Larger: Grooved-End, Ductile-Iron Spring Assisted Check Valves or Spring Actuated Silent Check Valves.

D. Gas Piping: Usethe following types of valves:
   1. Valves, NPS 2" and Smaller: Two-Piece, Copper-Alloy Ball Valves (Full Port).
   2. Valves, NPS 2-1/2" and 3":
      a. Two-piece or three-piece, Copper-Alloy Ball Valves (Full Port).
      b. Wafer-Lug, grooved-end, or flanged butterfly valves.
   3. Valves, NPS 4" and Larger: Wafer-Lug, grooved-end, or flanged butterfly valves.
   4. Pump Discharge Check Valves (Horizontal or Vertical), NPS 2" and Smaller: Bronze, Inline Lift Check Valves.
   5. Horizontal Check Valves, NPS 2" and Smaller: Bronze, Horizontal Swing Check Valves.
   6. Vertical Check Valves, NPS 2" and Smaller: Bronze, Inline Lift Check Valves.
   7. Pump Discharge Check Valves (Horizontal or Vertical), NPS 2-1/2" and Larger: Grooved-End, Ductile-Iron Spring Assisted Check Valves or Spring Actuated Silent Check Valves.
   8. Horizontal Check Valves, NPS 2-1/2" and Larger: Bronze, Horizontal Swing Check Valves.
   9. Vertical Check Valves, NPS 2-1/2" and Larger: Grooved-End, Ductile-Iron Spring Assisted Check Valves or Spring Actuated Silent Check Valves.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

A. Design Requirement: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer where using methods other than indicated.

B. Structural Performance: Hangers and supports for Plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test medium.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.4 QUALITY ASSURANCE

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

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

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

B. Trapeze Pipe Hanger Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.

1. Assemble and provide according to manufacturer's written instructions. Center piping on channel to evenly distribute load.

2. Pipe sizes and numbers shall be in accordance with the following:

TRAPEZE PIPE HANGER TABLE

PIPE SIZE	4"	3"	2 ½"	2"	1 ½"	1 ¼"	1"	TOTAL # of PIPES
NUMBER OF PIPES PERMITTED IN ONE CHANNEL SUPPORT	**2**	0	0	0	0	0	0	**2**
	0	**2**	**2**	0	0	0	0	**4**
	0	**2**	0	**4**	0	0	0	**6**
	0	**2**	0	0	**6**	0	0	**8**
	0	0	**4**	**2**	0	0	0	**6**
	0	0	**4**	0	**2**	**2**	0	**8**
	0	0	**4**	0	0	**8**	0	**12**
	0	0	0	**6**	**2**	**2**	**2**	**12**
	0	0	0	**8**	0	**2**	0	**10**
	0	0	0	0	**14**	0	0	**14**
	0	0	0	0	0	**16**	0	**16**

Notes:

1. Piping larger than 4" in diameter is not permitted in a channel support system.
2. Channel support systems shall be limited to eight (8) pipes per channel and two (2) channels (levels) per support system.
3. Smaller pipes can be substituted for larger pipes. For example two ¾" pipes may be installed in lieu of two 1" pipes, or 2" in lieu of 3", etc.
4. Spacing shall be in accordance with requirements for the smallest supported pipe. Refer to other specification sections for spacing requirements. If spacing requirements are not indicated comply with MSS SP-69.

C. Metal Framing Systems:

1. Available Manufacturers:
   a. Anvil International; a subsidiary of Mueller Water Products Inc.
   b. Empire Industries, Inc.
   c. ERICO International Corporation.
   d. Haydon Corporation; H-Strut Division.
   e. NIBCO INC.
   f. PHD Manufacturing, Inc.
   g. PHS Industries, Inc.
2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous slotted steel channel with 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. Coating: Zinc.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Available Manufacturers:

1. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.
9. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig, ASTM C 552, Type II cellular glass with 100-psig, or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

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" beyond sheet metal shield for piping operating below ambient air temperature.

2.4 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- orfield-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

1. Available Manufacturers:

   a. Cooper B-Line – Dura-Blok
   b. MAPA Products
   c. Mifab, Inc. – C-Port
   d. Miro Industries, Inc.
   e. OMG, Inc.
   f. PHP Systems/Design
   g. Pipe Prop
   h. Roof Top Blox

2. Provide pipe supports for supporting gas, condensate, refrigeration lines, or hydronic piping on flat roof surfaces. Support shall rest on roof surface without penetrating the roof surface. Supports for condensate piping shall be adjustable vertically to ensure pipe slopes as required.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Curb Mounted Pipe Stands: Shop- orfield-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.5 EQUIPMENT SUPPORTS

A. Description: Welded, shop or field fabricated equipment support made from structural carbon-steel shapes unless indicated otherwise.

2.6 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

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Provide 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, MSS SP-89, and Table above. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Provide in pipe hanger or shield for insulated piping.

E. Pipe Stand Installation: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

F. Provide 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. Provide 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. Provide lateral bracing with pipe hangers and supports to prevent swaying.

J. Provide building attachments within concrete slabs or attach to structural steel. Building attachments may not used on steel joists unless otherwise indicated. Provide additional attachments at concentrated loads, including valves, flanges, and strainers, 2-1/2" and larger and at changes in direction of piping. Provide concrete inserts before concrete is placed; fasten inserts to forms and provide reinforcing bars through openings at top of inserts.

K. Load Distribution: Provide hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Provide hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

M. Insulated Piping:

1. Attach clamps and spacers to piping.

   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Provide thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Provide MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

3. Provide MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

4. Shield Dimensions for Pipe: Not less than the following:

   a. Pipe ¼" to 3-½": 12 inches long and 0.048 inch thick.
   b. Pipe 4": 12 inches long and 0.06 inch thick.
   c. Pipe 5" and 6": 18 inches long and 0.06 inch thick.
   d. Pipe 8" to 14": 24 inches long and 0.075 inch thick.

5. Pipes 8" and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

6. Thermal-Hanger Shields: Provide with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Provide materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touchup: Unless otherwise indicated clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Provide same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and immediately apply galvanizing-repair paint. Paint shall comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Provide hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Provide nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Provide copper-plated pipe hangers and copper attachments for copper piping and tubing.

F. Provide padded hangers for piping that is subject to scratching.

G. Provide thermal-hanger shield inserts for insulated piping and tubing.

H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated provide the following:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of stationary pipes ½" to 30".
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes 4" to 14", requiring up to 4" of insulation.
3. Carbon- orAlloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes ¾" to 14", requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes ½" to 14" if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes ½" to 4", to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes ¾" to 8".
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes ½" to 8".
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes ½" to 8".
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes ½" to 8".
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes ½" to 8".
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS ½" to 3".
12. U-Bolts (MSS Type 24): For support of heavy pipes ½" to 14".
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes 4" to 14", with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes 4" to 14", with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes 2-½" to 14" if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes 1" to 14", from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes 2-½" to 14", from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes 2" to 14" if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes 2" to 14" if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes 2" to 14"if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

I. Vertical-Piping Clamps: Unless otherwise indicated provide the following:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers ¾" to 14".

2. Carbon- orAlloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers ¾" to 14" if longer ends are required for riser clamps.

J. Hanger-Rod Attachments: Unless otherwise indicated provide the following:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
6. Flat Plate, Double Nut, and Washer as Detailed on Structural Drawings: For attaching to bar joists. Method of attachment to bar joists must be approved by the structural engineer and joist manufacturer.

K. Building Attachments: Unless otherwise indicated provide the following:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Flat Plate, Double Nuts, and Washer as Detailed on Structural Drawings: For use under roof installations with bar-joist construction to attach to bottom chord of joist.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Provide 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.

L. Saddles and Shields: Unless otherwise indicated provide the followings:

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.

M. Spring Hangers and Supports: Unless otherwise indicated provide the following:

1. Restraint-Control Devices (MSS Type 47): To control pipe 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.

N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

P. Provide powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where indicated in concrete construction.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

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

B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

C. Valve Schedules: For each piping system to include in maintenance manuals.

D. 1/16" = 1'-0" scale drawing showing all valve locations to include in maintenance manuals.

1.3 QUALITY ASSURANCE

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

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, Aluminum, or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering

for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16-inch-thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16-inch-thick, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door markers, equipment markers, equipment signs, and similar operational instructions.

1. Stencil Material: Metal or fiberboard.
2. Stencil Paint: Exterior, gloss, black, unless otherwise indicated. Paint shall be low VOC and shall meet the requirements of section 09910. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, in colors according to ASME A13.1, unless otherwise indicated. Paint shall be low VOC and shall meet the requirements of section 09910.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, numbering scheme approved by Architect. Provide 5/32-inch hole for fastener.

1. Material: 0.032-inch- thick brass or
2. Material: 0.0375-inch- thick stainless steel or
3. Material: 3/32-inch- thick laminated plastic with 2 black surfaces and white inner layer.

B. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.

2.6 VALVE SCHEDULES

A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws and hangers.
2. Frame: Finished hardwood or extruded aluminum.
3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.7 VALVE PLAN

A. Valve Plan: Prepare a scale drawing. Provide the location and identity of each valve.

1. Valve Plan Frames: Glazed display frame for removable mounting on masonry walls for each page of valve plan. Include mounting screws and hangers.
2. Frame: Finished hardwood or extruded aluminum.
3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.8 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install and permanently fasten equipment nameplates on each major item of plumbing equipment that does not have nameplate or has a nameplate that is damaged or located where

not easily visible. Locate nameplates where easily visible. Include nameplates for the following general categories of equipment:

1. Fuel-burning units.
2. Pumps, compressors, and other motor-driven equipment.
3. Heat exchangers and similar equipment.
4. Water heaters and storage tanks.

B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.

1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
    a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
    b. Meters, gages, and thermometers.
    c. Fuel-burning units.
    d. Pumps, compressors, and other motor-driven equipment.
    e. Heat exchangers and similar equipment.
    f. Water heaters and storage tanks.

C. Stenciled Equipment Marker Option: Stenciled markers may be provided instead of laminated-plastic equipment markers, at Installer's option, if lettering larger than 1-inch high is needed for proper identification because of distance from normal location of required identification.

D. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where easily visible.

1. Identify mechanical equipment with equipment markers in the following color codes:
    a. Green: For cooling equipment and components.
    b. Yellow: For heating equipment and components.
    c. Orange: For combination cooling and heating equipment and components.
    d. Brown: For energy-reclamation equipment and components.
    e. Blue: For equipment not listed in a through d
2. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.

E. Stenciled Equipment Sign Option: Stenciled signs may be provided instead of laminated-plastic equipment signs, at Installer's option, if lettering larger than 1-inch high is needed for proper identification because of distance from normal location of required identification.

F. Install access panel markers with screws on equipment access panels.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in other sections.

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 25 feet.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Pipe Label Color Schedule:

1. Domestic Cold Water Piping:

   a. Background Color: Green.
   b. Letter Color: White.

2. Domestic Hot Water and Hot Water Return Piping:

   a. Background Color: Green.
   b. Letter Color: White.

3. Sanitary Waste and Storm Drainage Piping:

   a. Background Color: Green.
   b. Letter Color: White.

4. Natural Gas Piping:

   a. Background Color: Yellow.
   b. Letter Color: Black.

3.4 VALVE-TAG INSTALLATION

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

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:

1. Valve-Tag Size and Shape:

   a. Domestic Cold Water: 1 ½", round.
   b. Domestic Hot Water: 1 ½", round.
   c. Domestic Hot Water Recirculation: 1 ½", round.
   d. Natural Gas: 2", round.

2. Valve-Tag Color:

   a. Domestic Cold Water: Blue.
   b. Domestic Hot Water: Red.
   c. Domestic Hot Water Recirculation: Red.
   d. Natural Gas: Yellow.

3. Letter Color:

   a. Domestic Cold Water: Black.
   b. Domestic Hot Water: White.
   c. Domestic Hot Water Recirculation: White.
   d. Natural Gas: 2", Black.

3.5 VALVE SCHEDULE INSTALLATION

A. Mount valve schedules on wall in accessible location in each major equipment room and where directed by owner.

3.6 VALVE PLAN INSTALLATION

A. Mount valve plans on wall in accessible location in each major equipment room and where directed by owner.

3.7 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.8 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.9 CLEANING

A. Clean faces of mechanical identification devices and glass fronts of valve schedules and plans.

END OF SECTION 220553

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

A. Outdoor pipe: Pipe located outside the building insulation envelope.

B. Plenum: An unoccupied space or void, on the conditioned side of the building insulation and vapor barrier, being used to return conditioned air to the inlet side of a return or exhaust fan either directly or via a duct connection. An example would be a space with air handling light fixtures or openings in the ceiling used to transport air through the ceiling and then to an open duct located above the ceiling in another location.

C. Indirectly Conditioned Space: A space having no direct conditioning but, due to air movement induced by an exhaust, or return opening, is conditioned by makeup air from an adjacent space. An example would be a small toilet. Boiler rooms, fan rooms, and mechanical rooms do not qualify as indirectly conditioned spaces.

D. Inside the Building Insulation Envelope: For the purposes of this section, boiler rooms, fan rooms, and mechanical rooms are considered to be OUTSIDE the building insulation envelope.

E. Exposed: Visible from any angle without removal of building element or equipment.

F. Concealed: Enclosed in building element or above ceiling such that it is not visible from any angle without removal of building element or equipment.

1.3 SUBMITTALS

A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

B. Shop Drawings: Show fabrication and installation details for the following:

1. Detail application of removable insulation covers.
2. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
3. Detail attachment and covering of heat tracing inside insulation.
4. Detail insulation application at pipe expansion joints for each type of insulation.
5. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
6. Detail removable insulation at piping specialties, equipment connections, and access panels.
7. Detail application of field-applied jackets.
8. Detail application at linkages of control devices.
9. Detail field application for each equipment type.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Ship insulation materials in containers marked by manufacturer with type, grade, and maximum use temperature.

B. Ship Insulated Piping System Components on pallets and wood supports. Securely fasten and protect from damage. Store off the ground and cover with opaque waterproof tarp to protect materials from sunlight and rain.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping installer for piping insulation, duct installer for duct insulation, and equipment installer for equipment insulation.

C. Maintain clearances required for maintenance.

D. Coordinate installation and testing of heat tracing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers:

1. Mineral-Fiber Insulation:
   a. CertainTeed Manson.
   b. Johns Manville
   c. Knauf FiberGlass GmbH.
   d. Owens-Corning Fiberglas Corp.
   e. Schuller International, Inc.
2. Flexible Elastomeric Thermal Insulation:
   a. Armstrong World Industries, Inc.
   b. Rubatex Corp.
3. Polyolefin Insulation:
   a. Armstrong World Industries, Inc.
   b. IMCOA.
4. Closed-Cell Phenolic-Foam Insulation:
   a. Kooltherm Insulation Products, Ltd.

5. Removable Insulation Covers:
   a. Advance Thermal Corp.

2.2 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, with factory applied FSK Jacket. Meet the requirements of ASTM C 1290, Type III, inorganic glass fibers bonded by a thermosetting resin to maximum service temperature of 250°F. Faced insulation shall not exceed 25 Flame Spread, 50 Smoke Developed when tested in accordance with ASTM E84.

G. Semi-Rigid Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 1136, Type I, II, III, & IV with factory applied all-service jacket (ASJ) or Type II, IV with factory applied Foil Scrim Kraft (FSK) jacket.

H. Mineral-Fiber Blanket with Factory Applied FSK Jacket: Meet the requirements of ASTM C 1290, Type III, inorganic glass fibers bonded by a thermosetting resin with a multi-purpose foil-scrim kraft (FSK) jacket to maximum service temperature of 250°F. FSK shall meet the requirements of ASTM C 1136, Type II, when surface burning characteristics are determined in accordance with ASTM E 84 with the foil surface of the material exposed to the flame as it is in the final composite. Composite (insulation, facing and adhesive) shall not exceed 25 Flame Spread, 50 Smoke Developed when tested in accordance with ASTM E 84. Insulation properties shall be as follows:

1. Thickness: 1-1/2"
   a. Density: 0.75 pcf
   b. Minimum uncompressed R value: 5.0
   c. Minimum installed R value assuming 25% compression: 4.0
2. Thickness: 2"
   a. Density: 1.0 pcf
   b. Minimum uncompressed R value: 7.4
   c. Minimum installed R value assuming 25% compression: 6.0
3. Alternate to 2" 1.0 pcf: Thickness: 2.2"
   a. Density: 0.75 pcf
   b. Minimum uncompressed R value: 7.4
   c. Minimum installed R value assuming 25% compression: 6.0
4. Thickness: 3"
   a. Density: 0.75 pcf
   b. Minimum uncompressed R value: 10.0
   c. Minimum installed R value assuming 25% compression: 8.3

I. Medium Temperature Mineral-Fiber Blanket for Operating Temperatures from 250 to 850 deg F: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.

J. High Temperature Mineral-Fiber Blanket for Temperatures above 850 deg F: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.

K. Mineral-Fiber Pipe Insulation: Glass fibers bonded with a thermosetting resin complying with the following:

1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
2. Semi-Rigid Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 1136, Type I, II, III, IV with factory applied all-service jacket (ASJ) or Type II, IV with factory applied Foil Scrim Kraft (FSK) jacket.
3. Blanket Insulation: Comply with ASTM C 553, Type II, without facing.
4. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
5. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.
6. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

L. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Adhesive: As recommended by insulation material manufacturer.
2. Ultraviolet-Protective Coating: Asrecommended by insulation manufacturer.

M. Closed-Cell Phenolic-Foam: Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.

N. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

2.3 FIELD-APPLIED JACKETS

A. General: ASTM C 921, Type 1, unless otherwise indicated.

B. Glass Cloth: Woven glass-fiber fabric, plain weave, minimum 8 ounces per square yard.

C. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.

D. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.

1. Adhesive: As recommended by insulation material manufacturer.
2. PVC Duct Jacket Color: White or gray.
3. PVC Pipe Jacket Color: Color-code piping jackets based on materials contained within the piping system.

E. Aluminum Jacket: Deep corrugated sheets manufactured from aluminum alloy complying with ASTM B 209, and having an integrally bonded moisture barrier over entire surface in contact

with insulation. Factory cut and rolled to indicated sizes. Comply with ASTM B 209, 3003 alloy, H-14 temper.

1. Finish and Thickness: Stucco-embossed finish, 0.016 inch thick.
2. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.
3. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.

F. Stainless-Steel Jacket: Deep corrugated sheets of stainless steel complying with ASTM A 666, Type 304 or 316; 0.10 inch thick; and roll stock ready for shop or field cutting and forming to indicated sizes.

1. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.
2. Elbows: Gore type, for 45- and 90-degree elbows in same material, finish, and thickness as jacket.
3. Jacket Bands: Stainless steel, Type 304, 3/4 inch wide.

G. Heavy PVC Pipe Fitting Covers: Factory-fabricated fitting covers manufactured from 30-mil-thick, high-impact, ultraviolet-resistant PVC.

1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
2. Adhesive: As recommended by insulation material manufacturer.

H. Standard PVC Pipe Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil- thick, high-impact, ultraviolet-resistant PVC.

1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
2. Adhesive: As recommended by insulation material manufacturer.

2.4 REMOVABLE INSULATION COVERS

A. Pre-manufactured easily removable insulation cover/blanket intended for insulation of equipment and devices requiring periodic maintenance.

2.5 ACCESSORIES AND ATTACHMENTS

A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz. /sq. yd.

1. Tape Width: 4 inches.

B. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:

1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.
2. Galvanized Steel: 0.005 inch thick.
3. Aluminum: 0.007 inch thick.
4. Brass: 0.010 inch thick.
5. Nickel-Copper Alloy: 0.005 inch thick.

C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.

D. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.

1. Welded Pin Holding Capacity: 100 lb for direct pull perpendicular to the attached surface.

E. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct, pipe, plenum and breeching with adhesive. Pin length sufficient for insulation thickness indicated.

1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, pipes, plenums, and breechings; and to achieve a holding capacity of 100 lb. for direct pull perpendicular to the adhered surface.

F. Self-Adhesive Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct, pipe, and plenum with adhesive. Pin length sufficient for insulation thickness indicated.

2.6 VAPOR RETARDERS

A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

2.7 REMOVABLE INSULATION COVERS

A. Pre-manufactured easily removable insulation cover/blanket intended for insulation of equipment and devices requiring periodic maintenance.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

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

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of piping, and fittings.

B. Refer to schedules at the end of this Section for materials, forms, jackets, and thickness required for each system.

C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Apply multiple layers of insulation with seams staggered.

E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

F. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

G. Keep insulation materials dry at all times. Insulation that becomes wet or is otherwise damaged beyond repair shall be removed immediately and replaced. Replacement material and installation shall be in accordance with these specifications.

H. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

I. Apply insulation with the minimum number of joints practical.

J. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

K. Refer to special instructions for applying insulation over fittings, valves, and specialties.

L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.

1. Apply insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

M. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

N. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.
2. Joints and Seams: Cover with tape and vapor retarder as recommended by insulation material manufacturer to maintain vapor seal.
3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to pipe joints and fittings.

O. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.

P. Install vapor-retarder mastic on pipes and equipment.

1. Pipes and equipment with vapor retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.

2. Pipes and equipment without vapor retarders: Overlap insulation facing at seams and secure with outward clinching staples and pressure-sensitive tape having same facing as insulation.

Q. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.

1. Seal penetrations with vapor-retarder mastic.
2. Apply insulation for exterior applications tightly joined to interior insulation ends.
3. Seal insulation to roof flashing with vapor-retarder mastic.

R. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.

S. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.

T. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.

1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.

3.4 MINERAL-FIBER INSULATION APPLICATION

A. Blanket Applications for Pipes: Secure blanket insulation with adhesive, and anchor pins with speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of pipe surfaces.
2. Apply adhesive to entire circumference of pipes and to all surfaces of fittings and transitions.
3. Install anchor pins and speed washers on sides, top, and bottom of horizontal pipes.
4. Impale insulation over anchors and attach speed washers.
5. Cut excess portion of pins extending beyond speed washers. Cover exposed pins and washers with tape matching insulation facing.
6. 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 segment with 1/2-inch staples, 1-inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
7. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches o.c.
8. Apply insulation on pipe fittings and transitions with a full insulation segment for each surface. Apply insulation on pipe elbows with individually mitered gores cut to fit the elbow.
9. Insulate pipe hangers and flanges that protrude beyond the insulation surface with 6-inch-wide strips of the same material as insulation. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
10. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

B. Board Applications for Equipment: Secure board insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct, plenum, & equipment surfaces.
2. Apply adhesive to all surfaces of fittings and equipment.
3. Cut excess portion of pins extending beyond speed washers. Cover exposed pins and washers with tape matching insulation facing.
4. 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 segment with 1/2-inch staples, 1-inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
5. Insulate equipment stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6" wide strips of the insulating material. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
6. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

3.5 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Apply insulation to ducts, plenums, and equipment as follows:

1. Follow the manufacturer's written instructions for applying insulation.
2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the duct, plenum, and equipment surface.

3.6 CLOSED-CELL PHENOLIC-FOAM INSULATION APPLICATION

A. Apply insulation as follows:

1. Secure each layer of insulation with stainless-steel bands at 12-inch intervals and tighten without deforming the insulation materials.
2. Apply two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch, soft-annealed, stainless steel wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. On exposed applications, finish insulation with a skim coat of mineral-fiber, hydraulic-setting cement to surface of installed insulation. When dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin the finish coat to achieve smooth finish.

3.7 FIELD-APPLIED JACKET APPLICATION

A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.

1. Apply jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of jacket manufacturer's recommended adhesive.
3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

3.8 FINISHES

A. Glass-Cloth Jacketed Insulation: Paint insulation finished with glass-cloth jacket as indicated.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color shall be as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

3.9 APPLICATIONS

A. Insulation materials and thickness are specified at the end of this Section.

B. Insulate all pipe and equipment:

1. Insulate pipe in accordance with the application schedule(s) below.
2. Exceptions: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
   a. Vibration-control devices.
   b. Testing agency labels and stamps.
   c. Nameplates and data plates.
   d. Manholes.
   e. Handholes.
   f. Cleanouts.
   g. Plastic Condensate Drain piping.
   h. Factory-insulated equipment.
   i. Flexible connectors.

3.10 INDOOR APPLICATION SCHEDULE (ABOVE GRADE):

A. Service: Domestic cold-water, hot-water, tepid-water, and circulated water.

1. Insulation Material: Mineral fiber preformed pipe insulation with factory-applied ASJ or FSK jacket or flexible elastomeric pipe insulation.

2. Insulation Thickness: Apply the following insulation thicknesses:

   a. 40ºF – 60ºF Systems
      1) Less than 1" in diameter: ½"
      2) 1" through 1¼" in diameter: ½"
      3) 1½" through 3" in diameter: 1"
      4) 3" through 6" in diameter: 1"
      5) 8" in diameter: 1"

   b. 61ºF – 140ºF Systems
      1) Less than 1" in diameter: 1"
      2) 1" through 1¼" in diameter: 1"
      3) 1½" through 3" in diameter: 1½"
      4) 3" through 6" in diameter: 1½"
      5) 8" in diameter: 1½"

3. Vapor Retarder Required: Yes, for domestic cold-water systems; No, for domestic hot-water systems.
4. Finish: Exposed = Painted; Concealed = None.

B. Service: Exposed piping:

1. Mineral fiber preformed pipe insulation with Factory Applied FSK Jacket.
2. Insulation Thickness: 1"
3. Vapor Retarder Required: Yes.
4. Finish: Exposed = Painted; Concealed = None.

C. Service: Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Drainage from any Equipment. Measurement shall be pipe length.
1. Insulation Material: Mineral fiber preformed pipe insulation with Factory Applied FSK Jacket.
2. Insulation Thickness: 1"
3. Vapor Retarder Required: Yes.
4. Finish: Exposed = Painted; Concealed = None.

3.11 INDOOR APPLICATION SCHEDULE (BELOW GRADE):

1. None required.

END OF SECTION 220700

SECTION 221113 – FACILITY NATURAL-GAS PIPING

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 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.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 65 psig minimum unless otherwise indicated.
3. Service Meter: 65 psig minimum unless otherwise indicated.

B. Gas System Pressures: Primary pressure from the utility is more than 2.0 psig and is reduced to a secondary pressure of 2.0 psig by a pressure reducing valve installed immediately downstream of the meter and is reduced again by pressure reducing valves located at each piece of equipment.

1.4 SUBMITTALS

A. Product Data: For each type of the following:

1. Piping specialties.
2. Corrugated, stainless-steel tubing with associated components.
3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
4. Pressure regulators. Indicate pressure ratings and capacities.
5. Dielectric fittings.

B. Operation and Maintenance Data: For motorized gas valves, pressure regulators, and to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components and Devices: If indicated, provide electrical components and devices that are listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Applicable Codes: Comply with the Virginia Uniform Statewide Building Code and the International Fuel Gas Code.

C. Fuel Gas Piping: Listed and labeled as required by the International Fuel Gas Code.

D. UL Standard: Provide components listed in UL's "Gas and Oil Equipment Directory" where UL listing is indicated.

E. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

F. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from natural-gas piping according to requirements of authorities having jurisdiction.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

D. Protect stored PE pipes and valves from direct sunlight.

1.7 PROJECT CONDITIONS

A. Perform site survey: Contract with utility-locating service for area where Project is located and locate utilities.

B. Design values of fuel gas supplied for these systems are as follows:

1. Nominal Heating Value: 1000 Btu/cu.ft.
2. Nominal Specific Gravity: 0.6.

C. Interruption of Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:

1. Notify Owner and Architect no fewer than two days in advance of proposed interruption of natural-gas service.
2. Do not proceed with interruption of natural-gas service without Owner and Architect's written permission.

1.8 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.

C. Coordinate with equipment and regulator manufacturer's recommendations and local utility service provider for final regulator and accessory selections.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.2 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
    a. Material Group: 1.1.
    b. End Connections: Threaded or butt welding to match pipe.
    c. Lapped Face: Not permitted underground.
    d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
    a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

2.3 PROTECTIVE COATING

A. Furnish pipe and fittings with factory-applied, corrosion-resistant polyethylene coating for use in corrosive atmosphere.

2.4 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.5 VALVES

A. Refer to section "General Duty Valves for Plumbing Piping".

2.6 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.
8. Maximum Length: 72"

B. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for 2" and smaller; flanged ends for 2 ½" and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

C. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.7 SPECIALTY VALVES

A. Available Manufacturers:

1. ASCO General Controls.
2. Automatic Switch Co.
3. Eaton Corp.; Controls Div.
4. Honeywell, Inc.
5. Johnson Controls, Inc.

2.8 Valves, 2" and Smaller: Ball valves with threaded ends according to ASME B1.20.1 for pipe threads.

2.9 Valves, 2-1/2" and Larger: Butterfly valves for use with flanged ends according to ASME B16.5 for steel flanges.

2.10 PRESSURE REGULATORS

A. Available Manufacturers:

1. Line Pressure Regulators:
   a. American Meter Co.
   b. Donkin: Bryan Donkin RMG Canada, Ltd.
   c. Eclipse Combustion, Inc.
   d. Equimeter, Inc.
   e. Fisher Controls International, Inc.
   f. Maxitrol Co.
   g. National Meter.
   h. Richards Industries, Inc.; Jordan Valve Div.
   i. Schlumberger Industries; Gas Div.

B. Description: Single stage and suitable for fuel gas service. Include steel jacket and corrosion-resistant components, elevation compensator, and atmospheric vent.

1. 2" and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.
2. 2 ½" and Larger: Flanged ends according to ASME B16.5 for steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
3. Line Pressure Regulators: ANSI Z21.80 with 5-psig- minimum inlet pressure rating.
4. Appliance Pressure Regulators: ANSI Z21.18 with 2-psig minimum inlet pressure. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction. If vents are required provided piping necessary to extend to termination location outside the building as approved by the architect.

C. Pressure Regulator Vents: Factory- or field-installed, corrosion-resistant screen in opening if not connected to vent piping. Extend to exterior of building and terminate in location approved by the architect.

D. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Available Manufacturers:
   a. Canadian Meter Company Inc.
   b. Eaton Corporation; Controls Div.
   c. Harper Wyman Co.
   d. Maxitrol Company.
   e. SCP, Inc.
2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.

5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 2 psig.

2.11 CONCRETE BASES

A. Description: Reinforced concrete base formed of 3000-psi- minimum, 28-day compressive strength concrete, and measuring 6 inches thick and 6 inches larger in each dimension than equipment, unless otherwise indicated.

2.12 DIELECTRIC FITTINGS

A. Dielectric Unions:

1. Available Manufacturers:

    a. Capitol Manufacturing Company.
    b. Central Plastics Company.
    c. Hart Industries International, Inc.
    d. McDonald, A. Y. Mfg. Co.
    e. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
    f. Wilkins; Zurn Plumbing Products Group.
    g. Conbraco Industries-Apollo
2. Minimum Operating-Pressure Rating: 150 psig.
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

B. Dielectric Flanges:

1. Available Manufacturers:

    a. Capitol Manufacturing Company.
    b. Central Plastics Company.
    c. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
    d. Wilkins; Zurn Plumbing Products Group.
2. Minimum Operating-Pressure Rating: 150 psig.
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

C. Dielectric-Flange Kits:

1. Available Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Minimum Operating-Pressure Rating: 150 psig.
3. Companion-flange assembly for field assembly.
4. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or PE bolt sleeves, phenolic washers, and steel backing washers.
5. Insulating materials suitable for natural gas.
6. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.13 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

3.1 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.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off fuel gas to premises or piping section.

B. Inspect natural-gas piping according to the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 SERVICE ENTRANCE PIPING

A. Extend fuel gas piping and connect to fuel gas distribution piping downstream of meter.

1. Service meter will be provided by Local Gas Utility.

B. Install dielectric fitting downstream from and adjacent to each service meter unless meter is supported from service-meter bar with integral dielectric fitting. Install shutoff valve downstream from and adjacent to dielectric fitting. Refer to Division 22 Section "Common Work Results for Plumbing" for dielectric fittings.

3.4 CONCRETE BASE INSTALLATION

A. Locate bases at service meters and service regulators.

B. Excavate earth and make level beds to support bases. Form and pour concrete bases level with top surface projecting approximately 3 inches above grade.

3.5 OUTDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Section "Earth Moving" for excavating, trenching, and backfilling.

1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.

C. Install underground, PE, natural-gas piping according to ASTM D 2774.

D. Steel Piping Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.

E. Copper Tubing Protective Coating:

1. Apply joint cover kits over tubing to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.

F. Install fittings for changes in direction and branch connections.

G. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified in Section "Meters and Gages for Plumbing Piping."

3.6 INDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to are accepted by architect.

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.

E. Install piping indicated to be exposed and piping in equipment rooms 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 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 service regulators, 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 Floors: Install pre-sleeved corrugated, stainless-steel tubing systems for natural-gas. Cover with minimum of 1-1/2 inches of concrete. Jacket may not be in physical contact with metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives.
3. 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.

4. 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. Connect branch piping from top or side of horizontal piping.

R. Install unions in pipes 2" and smaller, adjacent to each valve, at final connection to each piece of equipment and where otherwise indicated. 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 automatic or electrically operated valve.

U. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Section "Meters and Gages for Plumbing Piping."

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section "Sleeves and Sleeve Seals for Plumbing Piping."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section "Sleeves and Sleeve Seals for HVAC Piping."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

Y. Install corrugated, stainless-steel tubing system according to manufacturer's written instructions. Include striker plates to protect tubing from puncture where tubing is restrained and cannot move.

Z. Install containment casings for gas piping below slabs extending minimum of 2 inches beyond point where pipe emerges from the floor. Tightly seal ends around gas piping using mechanical sleeve seals.

3.7 SERVICE-METER ASSEMBLY INSTALLATION

A. Provide concrete base for service meter.

B. Install locking shutoff valves downstream from service regulator. Shutoff valves are not required at second regulator if two regulators are installed in series.

C. Install strainer on inlet of service-pressure regulator.

D. Install service pressure regulator mounted outside with vent outlet horizontal or facing down. Install screen in vent outlet if not integral with service regulator.

E. Install metal shutoff valves upstream from service meters. Install dielectric fittings downstream from service meters.

3.8 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.9 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. 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.

G. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.10 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and supports specified in Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. 1" and Smaller: Maximum span, 96"; minimum rod size, 3/8".
2. 1¼": Maximum span, 108"; minimum rod size, 3/8".
3. 1½" and 2": Maximum span, 108"; minimum rod size, 3/8".
4. 2½" to 3 ½": Maximum span, 10'-0"; minimum rod size, ½".
5. 4" and Larger: Maximum span, 10'-0"; minimum rod size, 5/8".

C. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:

1. 3/8": Maximum span, 48"; minimum rod size, 3/8".
2. ½": Maximum span, 72"; minimum rod size, 3/8 ".
3. ¾" and Larger: Maximum span, 96"; minimum rod size, 3/8".

3.11 CONNECTIONS

A. Connect to utility's gas meter according to utility's procedures and requirements.

B. Install piping adjacent to appliances to allow service and maintenance of appliances.

C. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72" of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.12 PIPING APPLICATIONS

A. Flanges, unions, transition, and special fittings with pressure ratings same as or higher than system pressure rating may be used in applications below, unless otherwise indicated.

B. Above Ground Exposed Fuel Gas Piping:

1. Sizes up to 2":
   a. Steel pipe, malleable-iron threaded fittings, and threaded joints.

b. Pre-sleeved corrugated stainless-steel piping shall only be used for final equipment whip connections, kept to 5' or less, and only where approved by AHJ. Sizing shall be determined based on equivalent hydraulic diameter and not direct transfer of size.

2. 2½" to 4":
   a. Steel pipe, malleable-iron threaded fittings, and threaded joints, or steel pipe, steel welding fittings, and welded joints.
3. Larger Than NPS 4:
   a. Steel pipe, steel welding fittings, and welded joints.

C. Above Ground Concealed Fuel Gas Piping:

1. Sizes up to 2":
   a. Steel pipe, malleable-iron threaded fittings, and threaded joints.
2. 2½" to 4":
   a. Steel pipe, malleable-iron threaded fittings, and threaded joints, or steel pipe, steel welding fittings, and welded joints.
3. Larger Than NPS 4:
   a. Steel pipe, steel welding fittings, and welded joints.

D. Exterior Underground Fuel Gas Piping:

1. All Sizes: Polyethylene pipe, fittings and joining materials.

E. Under Slab Fuel Gas Piping: (NOTICE: Method of fuel gas piping installation below floor slab must be approved by the local code authority.)

1. Pre-Sleeved Corrugated, Stainless-Steel Tubing Systems.
2. Steel pipe, steel welding fittings, and welded joints with welded steel vented conduit.

3.13 LABELING AND IDENTIFYING

A. Comply with requirements in Section "Identification for Plumbing Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12" minimum below finished grade.

1. Exception: 6 minimum below sub-grade under pavements and slabs.

3.14 PAINTING

A. Use materials and procedures in Division 9 Section "Painting," "Exterior Paint Schedule" Article, "Ferrous Metal" Paragraph, "Full-Gloss, Alkyd-Enamel Finish" Subparagraph.

B. Paint exterior service meters, pressure regulators, specialty valves, piping, and accessories.

1. Color: Gray.

3.15 FIELD QUALITY CONTROL

A. Inspect, test, and purge piping according to ANSI Z223.1, Part 4 "Inspection, Testing, and Purging," and requirements of authorities having jurisdiction.

B. Repair leaks and defects with new materials and retest system until satisfactory results are obtained.

C. Report test results promptly and in writing to Architect and authorities having jurisdiction.

D. Verify capacities and pressure ratings of service meters, pressure regulators, valves, and specialties.

E. Verify correct pressure settings for pressure regulators.

F. Verify that specified piping tests are complete.

3.16 ADJUSTING

A. Adjust controls and safety devices. Replace damaged and malfunctioning controls and safety devices.

END OF SECTION 221113

SECTION 221116 –DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing domestic water piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
   1. Domestic Water Service Piping: 160 psig.
   2. Domestic Water Distribution Piping: 125 psig.

B. Seismic Performance: Refer to structural drawings for seismic category. Domestic water piping, support, and installation shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7, state, and local codes.

1.3 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Water Samples: Specified in "Cleaning" Article.

C. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
   1. Fire-suppression-water piping.
   2. Domestic water piping.
   3. Compressed air piping.
   4. HVAC hydronic piping.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. NSF/ANSI Compliance:
   1. NSF/ANSI 14, "Plastic Piping System Components and Related Materials"
   2. NSF/ANSI 61, "Drinking Water System Components – Health Effects"
   3. NSF/ANSI 372, "Drinking Water System Components – Lead Content"

4. ASTM F 876, "Standard Specification for Crosslinked Polyethylene (PEX) Tubing"
5. ASTM F 877, "Standard Specification for Crosslinked Polyethylene (PEX) Hot-Water and Cold-Water Distribution Systems"
6. ASTM F 3226, "Standard Specification for Metallic Press-Connect Fittings for Piping and Tubing Systems

1.5 PROJECT CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
   1. Notify Architect, Construction Manager, and Owner no fewer than two days in advance of proposed interruption of water service.
   2. Do not proceed with interruption of water service without Architect's, Construction Manager's, and Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) and ASTM B 88, Type M (ASTM B 88M, Type C) water tube, drawn temper.
   1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
   2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
   3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
   4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
   5. Metallic Press-Connect Fittings ASTM F 3226, NSF 61, and NSF 372:
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Conex Banninger
         2) Elkhart Products Corporation; Industrial Division.
         3) Mueller Industries
         4) NIBCO INC.
         5) Viega, LLC.
      b. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM sealing element in each end.
      c. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Cast-bronze or wrought-copper fitting with EPDM sealing element in each end.
   6. Copper Push-on-Joint Fittings:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1) NVent LLC.
b. Description: Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22; with stainless-steel teeth and EPDM sealing element in each end instead of solder-joint ends.

7. Copper-Tube Extruded-Tee Connections:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) T-DRILL Industries Inc.
   b. Description: Tee formed in copper tube according to ASTM F 2014.
8. Grooved-Joint Copper-Tube Appurtenances:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Anvil International.
      2) Shurjoint Piping Products.
      3) Victaulic Company.
   b. Copper Grooved-End Fittings: ASTM B 75 (ASTM B 75M) copper tube or ASTM B 584 bronze castings.
   c. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.

B. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) and ASTM B 88, Type L (ASTM B 88M, Type B) water tube, annealed temper.
1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
2. Metallic Press-Connect Fittings ASTM F 3226, NSF 61, and NSF 372:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Conex Banninger
      2) Elkhart Products Corporation; Industrial Division.
      3) Mueller Industries
      4) NIBCO INC.
      5) Viega, LLC.
   b. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM sealing element in each end.
   c. NPS 3 and NPS 4 (DN 80 and DN 100): Cast-bronze or wrought-copper fitting with EPDM sealing element in each end.

2.3 CPVC PIPING

A. CPVC Pipe: ASTM F 411/F 411M, [Schedule 40] [and] [Schedule 80].
1. CPVC Socket Fittings: [ASTM F 438 for Schedule 40] [and] [ASTM F 439 for Schedule 80].
2. CPVC Threaded Fittings: ASTM F 437, Schedule 80.

B. CPVC Piping System: ASTM D 2846/D 2846M, SDR 11, pipe and socket fittings.

C. CPVC Tubing System: ASTM D 2846/D 2846M, SDR 11, tube and socket fittings.

2.4 PEX TUBE AND FITTINGS

A. PEX Distribution System:
   1. ASTM F 876, ASTM F 877, CSA B137.5, NSF/ANSI 14, NSF/ANSI 61, and NSF/ANSI 372. All pipe shall be high-density crosslinked polyethylene. Pipe shall be rated for continuous operation above the designed system operating temperatures and pressures.
   2. Fittings for PEX Tube:
      a. All Fittings used with crosslinked polyethylene (PEX) water distribution pipe intended for plumbing applications shall be approved by manufacturer for use with PEX tubing.
         1) ASSE 1061 Brass Push-Fit Fittings.
         2) ASTM F 1807 Metal Insert Fittings Assembled with Copper Crimp Rings.
         3) ASTM F 1960 Cold Expansion Fittings, Metal and Polymer, with PEX Reinforcing Rings.
         4) ASTM F 2080 Cold Expansion Fittings with Metal Compression Sleeves.
         5) ASTM F 2098 Stainless-Steel Clamps with ASTM F 1807 Brass Insert Fittings.
         6) ASTM F 2159 Plastic Insert Fittings Assembled with Copper Crimp Rings.
         7) ASTM F 3347 Metal Insert Fittings with Stainless-Steel Press Sleeves.
         8) ASTM F 3348 Polymer Insert Fittings with Stainless-Steel Press Sleeves.
      b. All polymer fittings shall be made from modified PPSU (black) or equivalent Poly-Alloy polymer.
      c. All brass fittings shall be lead-free brass made from ECO BRASS UNS C69300/UNS C87850, Bronze UNS C87700/UNS C87710 or equivalent.
      d. All compression sleeves shall be made from PEX crosslinked polyethylene.
      e. All fittings shall be third-party certified to applicable standards ASTM F877, NSF/ANSI 14, NSF/ANSI 61 and CSA B137.5.
      f. Where joints are encased in concrete or buried underground, joints shall be wrapped if required per the manufacturer's recommendation to protect the material.
   3. Manifolds:
      a. Material: Distribution manifolds shall be manufactured of copper and be supplied by the piping manufacturer as a proven cataloged part of the manufacturer's system.
      b. Copper manifolds
      c. Copper manifolds shall be manufactured from Type L copper.
      d. Copper and/or brass outlets shall be high-temperature brazed (lead-free) into headers.

2.5 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.
   1. Use CPVC solvent cement that has a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to other sections for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

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 may be used on aboveground piping, unless otherwise indicated.

C. Fitting Options:
   1. Mechanically formed tee-branch outlets (T-Drill) and brazed joints may be used on aboveground copper tubing.
   2. Press-Connect Fittings: Mechanically joined fittings with elastomeric sealing element.

D. Underground Domestic Water Service Piping: Match civil materials to first flange.

E. Aboveground Domestic Water Piping: Use the following piping materials for each size range:
   1. 2" and Smaller:
      a. Hard copper tube, Type L copper pressure fittings; and soldered joints.
      b. CPVC, Schedule 40 pipe with socket fittings and solvent-cemented joints.
      c. PEX pipe with approved PEX fittings.
         1) ASSE 1061 Brass Push-Fit Fittings.
         2) ASTM F 1807 Metal Insert Fittings Assembled with Copper Crimp Rings.
         3) ASTM F 1960 Cold Expansion Fittings, Metal and Polymer, with PEX Reinforcing Rings.
         4) ASTM F 2080 Cold Expansion Fittings with Metal Compression Sleeves.
         5) ASTM F 2098 Stainless-Steel Clamps with ASTM F 1807 Brass Insert Fittings.
         6) ASTM F 2159 Plastic Insert Fittings Assembled with Copper Crimp Rings.
         7) ASTM F 3347 Metal Insert Fittings with Stainless-Steel Press Sleeves.
         8) ASTM F 3348 Polymer Insert Fittings with Stainless-Steel Press Sleeves.
   2. 2-1/2" and above":
      a. Hard copper tube, Type L copper pressure fittings; and soldered joints.

b. Hard copper tube, Type L with grooved ends; copper grooved-end fittings; copper-tubing, keyed couplings; and grooved joints.

F. Underground Domestic Water Piping: Use the following piping materials for each size range:
1. 2" and Smaller:
a. Soft copper tube, Type K copper pressure fittings; and soldered joints with no joints permitted below concrete slabs.
b. PEX continuous pipe with no joints or fittings below grade.
2. 2-1/2" and above:
a. Soft copper tube, Type K copper pressure fittings; and soldered joints.

G. CPVC and PEX materials shall NOT be used for the following applications:
1. Domestic hot water and recirculation systems where design temperatures exceed 120 degrees F.
2. Domestic cold, hot, and recirculation piping and fittings directly serving domestic water booster pump and domestic water heating equipment.
3. Domestic water service entrance equipment.

3.3 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shutoff Duty: Use bronze ball valves for piping NPS 2 and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 and larger.
2. Throttling Duty: Use bronze ball valves for piping NPS 2 and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 and larger.
3. Hot-Water-Piping, Balancing Duty: Use automatic flow control valves.
4. Drain Duty: Hose-end drain valves.

3.4 PIPING INSTALLATION

A. Extend domestic water service piping to exterior water distribution piping in sizes and locations indicated.

B. Install underground ductile-iron piping according to AWWA C600, and AWWA M41. Install buried piping inside building between wall and floor penetrations and connection to water service piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
1. Encase piping with polyethylene film according to ASTM A 674 or AWWA C105.

C. Install underground copper according to CDA's "Copper Tube Handbook."

D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight.

E. Install water-pressure regulators downstream from shutoff valves.

F. Install aboveground domestic water piping level and plumb.

G. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.

H. Perform the following steps 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. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
6. Remove filter cartridges from housings and verify that cartridges are as specified for application, where used and that cartridges are clean and ready for use.

I. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.

J. Check plumbing specialties and verify proper settings, adjustments, and operation.
1. Water-Pressure Regulators: Set outlet pressure at 80 psig maximum, unless otherwise indicated.

K. Energize pumps and verify proper operation.

L. Store and protect plastic piping and fittings in packaging with labeling in place.
1. Pipe and fittings shall be kept in original packaging until required for installation.
2. Do not expose pipe and fittings to ultraviolet (UV) light beyond exposure limits recommended by manufacturer.
3. Protect products from exposure of contaminating materials. Install suitable plugs in open pipe ends until installation when necessary.
4. Piping shall not be dragged across the ground or other surfaces and shall be stored on a flat surface with no sharp edges.
5. Pipe and fittings shall be protected from other trades, oil, grease, paint, direct sunlight, and other elements as recommended by the manufacturer.

3.5 JOINT CONSTRUCTION

A. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

B. Mechanically Formed Outlets: Form tee in copper tube according to equipment manufacturer's written instructions. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

C. Metallic Press-Connect fittings shall be installed in accordance with manufacturer's installation instructions, installer shall have attended a manufacturer's installation training, and have current training credentials.

3.6 VALVE INSTALLATION

A. Install sectional valve close to water main on each branch and riser serving plumbing fixtures or equipment. Use ball valves for piping NPS 2 and smaller. Use butterfly valves for piping NPS 2-1/2 and larger.

B. Install shutoff valve on each water supply to equipment and on each water supply to plumbing fixtures without supply stops. Use ball valves for piping NPS 2 and smaller. Use butterfly valves for piping NPS 2-1/2 and larger.

C. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger.

3.7 HANGER AND SUPPORT INSTALLATION

A. Refer to Section 220529 "Hangers and Supports for Plumbing Piping" for pipe hanger and support devices.

B. Install the following:
   1. Vertical Piping: MSS Type 8 or Type 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs: According to the following:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet, if indicated: MSS Type 49, spring cushion rolls.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
   2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
   3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
   4. NPS 2-1/2: 108 inches with 1/2-inch rod.
   5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
   6. NPS 6: 10 feet with 5/8-inch rod.
   7. NPS 8: 10 feet with 3/4-inch rod.

F. Where hangers for piping are to be suspended from open-web steel joists, install hangers at maximum spacing that will result in hanger loads that comply with the requirements on the structural drawings.

G. Install supports for vertical copper tubing every 10 feet.

H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

I. Where bends in the pipe occur, place hangers 1/3 of the maximum allowed spacing distance of the bend (i.e. is the maximum span is 12 feet, the hanger shall be 4 feet from the bend. Pipe shall be supported from both sides of the bend.

3.8 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water service piping. Use transition fitting to join dissimilar piping materials.

3.9 FIELD QUALITY CONTROL

A. Inspect domestic water piping as follows:
   1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
   2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
      b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
   3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
   4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test domestic water piping as follows:
   1. Step test for Press-Connect fittings following manufacturer's recommendations prior to system pressure testing shall be performed to identify any unpressed connections.
   2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   3. Leave uncovered and unconcealed new, altered, extended, or replaced domestic water piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
   5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.

6. Prepare reports for tests and required corrective action.

3.10 ADJUSTING

A. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
   1. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow of hot water in each branch, starting at the most remote branch and working back to circulation pump. Verify and document settings and conditions at each branch and circulation pump during each round of system balancing.
   2. Repeat above balancing sequence until all balancing valve branches are maintaining desired setpoints. Verify and document final settings and conditions. Prepare and submit balancing report for each circulation system to engineer of record and owner.

3.11 CLEANING

A. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

B. Clean and disinfect potable domestic water piping as follows:
   1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
   2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in AWWA C651, AWWA C652 or as described below:
      a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
      b. Fill and isolate system according to either of the following:
         1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
         2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
      c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
      d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities to engineer or record, owner, and authorities having jurisdiction.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.3 SUBMITTALS

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

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. NSF Compliance:

1. Comply with NSF 61, "Drinking Water System Components – Health Effects"
2. Comply with NSF 372, "Drinking Water System Components – Lead Content"
3. Comply with NSF 14, "Plastic Piping System Components and Related Materials"

C. Water Management Installation:

1. Installer Qualifications: An installer who is authorized by the equipment manufacturer for both installation and maintenance of submitted equipment.
2. Provide documentation demonstrating previous experience and successfully completing projects of similar size and scope.
3. Provide a list of installations that the Installer has specifically installed for verification by the Owner. Similar installations from other vendors and/or Installers shall be accepted. The Installer's employees must meet these qualifications.

4. The Installer shall demonstrate to the satisfaction of the Architect/Engineer that he has:
   a. Adequate plant and equipment to pursue the work properly and expeditiously.
   b. Adequate staff and technical experience to implement the work.

c. Suitable financial status to meet the obligations of the work.
d. Technical capable and factory trained service personnel at a local service facility to provide routine and emergency service for all products used in this project.

5. A contractor intending to bid on this work, not meeting the requirements of this section, may employ the services of an "Installer" meeting the requirements of this section. A "subcontractor" so employed must be acceptable to the Architect. The "Installer" shall be identified by submittal for acceptance by the Architect.

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type (Anti-siphon) Vacuum Breakers:

1. Available Manufacturers:

a. Ames Co.
b. Apollo Valves - Conbraco Industries, Inc.
c. Watts Industries, Inc.; Water Products Div.
d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1001.

3. Sizes: ¾" thru 3" as required to match connected piping.

4. Body: Brass or Bronze.

5. Inlet and Outlet Connections: Threaded.

6. Finish: Rough bronze or chrome plated.

B. Pressure Vacuum Breakers:

1. Available Manufacturers:

a. Ames Co.
b. Apollo Valves - Conbraco Industries, Inc.
c. Watts Industries, Inc.; Water Products Div.
d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Accessories:

a. Valves: Ball type, on inlet and outlet.

C. Spill-Resistant Vacuum Breakers:

1. Available Manufacturers:

a. Apollo Valves - Conbraco Industries, Inc.
b. Watts Industries, Inc.; Water Products Div.

2. Standard: ASSE 1056.

3. Operation: Continuous-pressure applications.

4. Sizes: ¾" thru 1" as required to match connected piping.
5. Accessories:
    a. Valves: Ball type, on inlet and outlet.

2.2 BACKFLOW PREVENTERS

A. Reduced-Pressure-Zone (RPZ) Backflow Preventers:

1. Available Manufacturers:
    a. Ames Co.
    b. Apollo Valves - Apollo Valves - Conbraco Industries, Inc.
    c. Watts Industries, Inc.; Water Products Div.
    d. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 10 psig maximum, through middle 1/3 of flow range.
5. Sizes: ¾" thru 10"
6. Body: Brass or bronze for 2" and smaller; cast iron or steel with interior lining complying with AWWA C550 or that is FDA approved for 2 ½" and larger.
7. Configuration: Comply with drawing requirements.
8. Accessories:
    a. Valves: Ball type with threaded ends on inlet and outlet of 2" and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of 2 ½" and larger.
    b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Double-Check Backflow Preventers:

1. Available Manufacturers:
    a. Ames Co.
    b. Apollo Valves - Apollo Valves - Conbraco Industries, Inc.
    c. Watts Industries, Inc.; Water Products Div.
    d. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1015
3. Application: continuous-pressure, unless otherwise indicated.
4. Pressure Loss: 8 psig maximum, through middle 1/3 of flow range.
5. Size: ¾" thru 10" as required to match connected piping.
6. Body: Brass or bronze for NPS 2 and smaller; cast iron or steel with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
7. Configuration: Comply with drawing requirements.
8. Accessories:

a. Valves: Ball type with threaded ends on inlet and outlet of 2" and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of 2 ½" and larger.

C. Dual-Check-Valve Backflow Preventers:

1. Available Manufacturers:
   a. Apollo Valves - Apollo Valves - Conbraco Industries, Inc.
   b. Mueller Co.; Water Products Div.
   c. Watts Industries, Inc.; Water Products Div.
   d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1024.
3. Operation: Continuous-pressure applications.
4. Sizes: ¾" thru 1" as required to match connected piping.
5. Body: Bronze with union inlet.

2.3 WATER PRESSURE-REDUCING VALVES

A. Available Manufacturers:

1. CLA-VAL Automatic Control Valves.
2. Flomatic Corporation.
3. OCV Control Valves.
4. Watts Industries, Inc.; Ames Fluid Control Systems.
5. Watts Industries, Inc.; Watts ACV.
6. Zurn Plumbing Products Group; Wilkins Div.

B. Description: Pilot-operation, diaphragm-type, single-seated main water control valve.

C. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.

D. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.

1. Sizes: 1¼" thru 10" as required to match connected piping.
2. Pattern: Angle or Globe-valve design.
3. Trim: Stainless steel.

2.4 CALIBRATED BALANCING VALVES

A. Available Manufacturers:

1. Armstrong Pumps, Inc.
2. Caleffi
3. Flow Design, Inc.
4. Griswold Controls
5. ITT Bell & Gossett; ITT Fluid Technology Corp.

6. Jomar Valves
7. Nexus Valve
8. NIBCO
9. NuTech Hydronic Specialty Products
10. Taco, Inc.

B. NPS 2 and Smaller: Bronze body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having threaded ends. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.

C. NPS 2-1/2 and Larger: Cast-iron or steel body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having flanged connections. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.

2.5 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Thermostatic Master Mixing Valves:

1. Refer to drawing schedule for manufacturer and operating requirements.
2. Available Manufacturers:
    a. Lawler Manufacturing Company, Inc.
    b. Leonard Valve Company.
    c. Powers; a Watts Industries Co.
    d. Symmons Industries, Inc.
3. Standard: ASSE 1017.
4. Pressure Rating: 125 psig.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: union inlets and outlet.
7. Accessories:
    a. Check stops on hot- and cold-water supplies.
    b. Handle.
    c. Dial thermometer on inlets and outlet.
    d. Pressure gauges on inlets and outlet.
8. Pressure Rating: 125 psig, unless otherwise indicated.

B. Individual-Fixture, Water Tempering Valves:

1. Refer to drawing schedule for manufacturer and operating requirements.
2. Available Manufacturers:
    a. Apollo Valves - Conbraco Industries, Inc.
    b. Lawler Manufacturing Company, Inc.
    c. Leonard Valve Company.
    d. Powers; a Watts Industries Co.
    e. Watts Industries, Inc.; Water Products Div.

f. Zurn Plumbing Products Group; Wilkins Div.

3. Standard: ASSE 1070, thermostatically controlled water tempering valve.
4. Pressure Rating: 125 psig minimum, unless otherwise indicated.
5. Body: Bronze body with corrosion-resistant interior components.
6. Temperature Control: Adjustable.
7. Inlets and Outlet: Threaded. Provide unions and valves.
8. Finish: Chrome-plated bronze.

2.6 STRAINERS

A. Pattern: "Y"

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron or steel with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:

   a. Strainers NPS 2 and Smaller: 0.033 inch.
   b. Strainers NPS 2-1/2 to NPS 4: 0.062 inch.
   c. Strainers NPS 5 and Larger: 0.10 inch.

6. Drain: Factory-installed, hose-end drain valve.

2.7 WATER HAMMER ARRESTERS

A. Available Manufacturers:
1. AMTROL, Inc.
2. Josam Company.
3. MIFAB, Inc.
4. PPP Inc.
5. Sioux Chief Manufacturing Company, Inc.
6. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
7. Tyler Pipe; Wade Div.
8. Watts Drainage Products Inc.
9. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Standard: ASSE 1010 or PDI-WH 201.

C. Type: Metal bellows or copper tube with piston.

D. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.8 TRAP GUARD

A. Available Manufacturers:
   1. ProSet Systems, Model TG
   2. SureSeal Manufacturing, Inline Floor Drain Trap Sealer

B. General:
   1. Comply with ASSE 1072-2007.
   2. ProSet Systems: Smooth, soft, flexible, elastomeric PVC material molded into shape, open on top with curl closure at bottom. SureSeal: ABS plastic body with neoprene rubber diaphragm and sealing gasket with 80 durometer compression fit sealing gasket on gravity drain outlet connection.
   3. Allows wastewater to open and adequately discharge floor drain through its interior.
   4. Closes and returns to original molded shape after wastewater discharge is complete.
   5. Size shall be as required to match drain in which it is installed.

2.9 HOSE BIBBS

A. Refer to plumbing fixture rough-in schedule on drawings.

2.10 WALL HYDRANTS

A. Refer to plumbing fixture rough-in schedule on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers where indicated: If not indicated on each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

   1. Locate backflow preventers in same room as connected equipment or system.
   2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air-breaks are not acceptable for this application.
   3. Do not install bypass piping around backflow preventers.

C. Install balancing valves with-in 12" of ceiling at access door or tile where they can be reached with-out obstruction.

D. Install thermostatic mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install thermometers and pressure gauges.
2. Install cabinet-type units recessed in or surface mounted on wall as indicated.

E. Install strainers where indicated.

F. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Section "Rough Carpentry."

G. Install water hammer arresters in water piping according to PDI-WH 201.

H. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1/8" per foot, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

I. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1/8" per foot, and connect to floor-drain body, trap, or inlet fitting.

J. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1/8" per foot, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

K. Install trap guards in accordance with manufacturer's instructions.

L. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.

M. Fasten recessed-type plumbing specialties to reinforcement built into walls.

N. Install wood-blocking reinforcement for wall-mounting and recessed-type plumbing specialties.

O. Install individual shutoff valve in each water supply to plumbing specialties. Use ball valve if specific valve is not indicated. Install shutoff valves in accessible locations. Refer to Section "Valves" for general-duty ball valves.

P. Install air vents at water piping high points. Include ball valve in inlet.

Q. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

R. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

S. Specific trap primer assembly and primer pipe routing not always indicated on plans to provide contactor field flexibility in selecting option best suitable for field conditions, where alternative

options may be acceptable. Contactor shall coordinate and provide any necessary items to facilitate proper installation and operation of the preferred and approved primer system; to include, but not limited to, electrical conduit and circuitry to the panelboard for electronic systems.

3.2 LABELING AND IDENTIFYING

A. Indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section "Plumbing Identification"

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each reduced-pressure-principal backflow preventer, double-check backflow-preventer and double-check, detector-assembly according to authorities having jurisdiction and the device manufacturer's recommendations.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.4 ADJUSTING

A. Set field-adjustable pressure set points.

B. Set field-adjustable flow set points.

C. Set field-adjustable temperature set points.

END OF SECTION 221119

SECTION 221125 - CIRCULATING PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.3 ABBREVIATIONS

A. BAS Building Automation System

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect against damage.

C. Comply with pump manufacturer's written instructions for handling.

PART 2 - PRODUCTS

2.1 CIRCULATING PUMPS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Grundfos Pumps Corp.
2. Bell & Gossett
3. Armstrong Pumps Inc.
4. TACO Incorporated.

B. Description: Factory-assembled and -tested, in-line, wet rotor or system lubricated, close-coupled, 100% lead-free, ECM or VFD controlled, overhung-impeller, designed for circulating domestic hot water.

C. Pump Construction:

1. Pump and Motor Assembly: Hermetically sealed, cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
2. Motor: Non-overloading at all points on the pump curve.
3. Casing: Bronze, with companion-flange connections.
4. Impeller: Bronze, Stainless Steel, or Composite.
5. Motor: Variable speed, unless otherwise indicated.

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

2.3 CONTROLS

A. BAS: Electric, adjustable for control of water-supply pump.

1. Type: Start/Stop
2. Operation of Pump: Refer to Section "Sequence of Operation".

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

B. Verify installation and location of automatic flow control valve(s). Record actual location(s) on as-built drawings.

3.2 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install in-line, centrifugal pumps with shaft horizontal unless otherwise indicated.

3.3 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to pumps to allow service and maintenance.

C. Connect domestic water piping to pumps.

D. Install suction and discharge piping.

E. Install indicated valves &devices.

F. Comply with Division 26 Sections for electrical connections.

G. Connect controls.

H. Interlock pump with water heater to deactivate water heater when pump is deactivated..

3.4 IDENTIFICATION

A. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.5 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Check operation of 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.
7. Close discharge valve.
8. Start motor.
9. Open discharge valve slowly.
10. Adjust temperature settings on thermostatic mixing valves if included in design.
11. Adjust balancing valves if required by thermostatic mixing valve manufacturer.
12. Adjust system balancing valves and pump set points to meet system performance requirements.
13. Check and record final pressure and flow conditions on inlet and outlet of pump.
14. Submit report of all final setpoints and conditions to owner.

END OF SECTION 221125

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

A. The following are industry abbreviations:

1. EPDM: Ethylene-propylene-diene terpolymer.
2. LEED: Leadership in Energy and Environmental Design
3. NBR: Acrylonitrile-butadiene rubber.
4. PE: Polyethylene plastic.
5. PVC: Polyvinyl chloride plastic.
6. TPE: Thermoplastic elastomer.
7. USGBC: United States Green Building Council

1.3 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.4 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Submittal:

1. Product Data for USGBC LEED Credit EQ 4.1: For solvent cements and adhesive primers, include printed statement of VOC content.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of testing agency.

B. Cast iron soil pipe shall be clearly marked with the manufacturer's name, county of origin, eight-digit date code, pipe diameter and length, relevant ASTM standard, and registered trademark of third part certifier.

1. Third party certifier shall be IAPMO, ICC, NSF, UL, or other organization that is accredited as an ANSI – Guide 65 organization. Reference www.ansi.org.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

B. Flexible Transition Couplings for Underground Non-Pressure Piping: ASTM C 1173 with elastomeric sleeve. Include ends of same sizes as piping to be joined and include corrosion-resistant metal band on each end.

2.2 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

B. Solvent Cement and Adhesive Primer:

1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Transition fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.

B. Aboveground, Soil, Waste, and Vent Piping located outside plenum: PVC pipe, PVC socket fittings, and solvent-cemented joints.

C. Underground, Soil, Waste, and Vent Piping: PVC pipe, PVC socket fittings, and solvent-cemented joints.

3.2 PIPING INSTALLATION

A. Refer to Section "Facility Sanitary Sewers" for Project-site sanitary sewer piping.

B. Refer to Section "Common Work Results for Plumbing" for basic installation.

C. Install seismic restraints on piping when indicated. Seismic-restraint devices are not required in zones A & B. Seismic-restraint devices are specified in Section "Vibration and Seismic Controls for Plumbing Piping and Equipment".

D. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

E. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.

F. Install seismic restraints on piping when indicated. Seismic-restraint devices are specified in Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

G. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

H. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight.

I. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back-to-back or side by side with common drainpipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

J. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

K. Install soil and waste drainage and vent piping at the minimum slopes required by authorities having jurisdiction.

L. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

M. Install underground PVC soil and waste drainage piping according to ASTM D 2321.

N. Install all drainage pattern fittings and piping in accordance with all applicable federal, state, and local codes.

O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

P. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install sleeve seals for piping penetrations of concrete and masonry walls and slabs. Comply with requirements for sleeve seals specified in Section "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section "Escutcheons for Plumbing Piping"

3.3 JOINT CONSTRUCTION

A. Refer to section "Common Work Results for Plumbing" for basic piping joint construction.

B. PVC Non-pressure Piping Joints: Join piping according to ASTM D 2665.

3.4 HANGER AND SUPPORT INSTALLATION

A. Refer to Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices in zones other than A & B.

B. Refer to Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices. Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:
    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet, if indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Install supports according to Section " Hangers and Supports for Plumbing Piping and Equipment."

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. 1 ½" and 2": 48" with 3/8" rod.
2. 3": 48" with ½" rod.
3. 4" and 5": 48" with 5/8" rod.
4. 6": 48" with ¾" rod.
5. 8" to 12": 48" with 7/8" rod.

G. Install supports for vertical PVC piping every 48".

H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping.

3.6 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections, and arrange for re-inspection.

C. Reports: Where required or indicated prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.

4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

5. Prepare reports for tests and required corrective action.

3.7 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.8 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

B. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 ABBREVIATIONS

A. RPZ Reduced Pressure Zone

B. FOG Fats, oils, and greases.

1.3 DEFINITIONS

A. Withstand: Units shall remain in place without separation of any parts when subjected to seismic forces indicated. "Essential facility" units shall be fully operational after the seismic event.

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.5 COORDINATION

A. Coordinate size and location of roof penetrations.

B. Coordinate accessories, extensions, collars, flashing clamps, etc… for field conditions and installation requirements for roof assemblies and other construction assemblies to provide final and proper compliant installation.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. General:

1. Available Manufacturers:
   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification

2. Standard: ASME A112.36.2M.
3. Size: Same as connected drainage piping
4. Closure Material: Match pipe, brass, PVC, or ABS

B. Floor Cleanouts:

1. Housing: threaded, adjustable.
2. Type: Threaded, adjustable housing.
3. Body: Cast iron.
4. Outlet Connection: Inside calk, Spigot, or Threaded.
5. Adjustable Housing Material: Cast iron with threads.
6. Frame and Cover Material and Finish: Satin finish nikaloy.
7. Frame and Cover Shape: Round or Square (Contractors Option).
8. Top Loading Classification: Extra Heavy Duty.
9. Riser: ASTM A 74, Service weight, cast-iron drainage pipe fitting and riser to cleanout.
10. Carpet Ring: Yes for carpeted floors.
11. Tile Recess: Yes for tiled floors.
12. Terrazzo: Yes for terrazzo floors

C. Wall Cleanouts:

1. Wall access: Yes
2. Body: Match connected piping.
3. Closure: Countersunk or raised-head, drilled-and-threaded plug.
4. Closure Plug Size: Same as cleanout size but not larger than four inches in diameter.
5. Wall Access: Round, flat, chrome-plated brass, nickel-bronze, copper-alloy, or stainless-steel cover plate with screw.

2.2 FLOOR DRAINS

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
   a. Josam Company; Josam Div.
   b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   c. Tyler Pipe; Wade Div.
   d. Watts Drainage Products Inc.
   e. Zurn Plumbing Products Group; Light Commercial Operation.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.3
3. Pattern: As indicated.
4. Clamping Flange: Required.

2.3 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

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

    a. ProSet Systems Inc.

2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Plastic Stack Fitting (For Use Where Plastic Stacks Are Indicated): ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating (For Use Where Plastic Laboratory Stacks are Indicated: Corrosion resistant on interior of fittings.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Floor-Drain, Trap-Seal Primer Fittings:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

    a. PPP
    b. Josam
    c. Smith
    d. Zurn

2. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
3. Size: Same as floor drain inlet.

B. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts.

C. Install cleanout deck plates with top flush with finished floor.

D. For wall cleanouts located in concealed piping, install cleanout access covers, with cover tight to finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
   1. Position floor drains as indicated. If indication is not clear, position for easy access and maintenance.
   2. Set floor drains at elevations indicated.
   3. Install floor-drain flashing flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
   4. Install individual traps for floor drains connected to sanitary building drain.

F. Install through-penetration firestop assemblies in plastic conductors and stacks at rated penetrations.

G. Install floor-drain, trap-seal primer fittings on inlet to floor drains indicated to receive trap-seal primer.

H. Install air-gap fittings on RPZ backflow preventers and where indicated.

I. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect grease interceptors and their installation, including piping and to assist in testing.

B. Checks and Inspections:

1. Leak Check: After installation, charge system and check for leaks. Repair leaks and recheck until no leaks exist.

3.4 PROTECTION

A. Protect drains during construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of open pipes at end of each day or when work stops.

END OF SECTION 221319

SECTION 223300 - ELECTRIC WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 BASIS OF DESIGN PRODUCT: As scheduled on the drawings or as otherwise indicated.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.4 SUBMITTALS

A. Product Data: For each type and size of water heater. Include electrical data, rated capacities, operating weights, furnished specialties, and accessories.

B. Shop Drawings: Detail water heater assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.

C. Maintenance Data: For water heaters to include in maintenance manuals specified in Division 1.

D. Warranties: Special warranties specified in this Section.

1.5 ABBREVIATIONS

A. AFF Above Finished Floor

B. EWH Electric Water Heater

C. WC Water Column

1.6 DEFINITIONS

A. Potable: Consumable, drinkable, or domestic.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain same type of water heaters through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of water heaters.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. ASME Compliance: Fabricate and label water heater, hot-water storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1 unless otherwise indicated.

E. ASHRAE Standards: Comply with performance efficiencies prescribed for the following:

1. ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings," for commercial water heaters.

1.8 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of water heaters that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. Begins on date of Substantial Completion:
b. Heating Elements: One year.
c. Storage Tanks: Three years.
d. Heat Exchangers: Three Years
e. Compressors: Three years.
f. Controls: One year.

PART 2 - PRODUCTS

2.1 ELECTRIC WATER HEATERS

A. Description: Small storage capacity units (2.50-50.00 Gallons) with limited heating capacity (6.00 kW maximum)

B. Manufacturers:

1. A.O. Smith

2. Hubbell

3. Rheem Manufacturing Co.; Rheem Water Heater Div.
4. Rheem Manufacturing Co.; Ruud Water Heater Div.
5. State Industries.
6. Bradford White Corp.
7. Lochinvar Corp.

C. Standards:

1. Comply with UL 174.
2. ASHRAE/IESNA 90.1
3. Listed by manufacturer for commercial applications.

D. Storage Tank Construction: Steel or corrosion-resistant metal with 150-psig working-pressure rating.

1. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, drain, anode rod, and controls. Attach tappings to tank before testing and labeling.
2. Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
3. Insulation: Comply with ASHRAE 90.1. Surround entire storage tank except connections and controls.
4. Jacket: Steel, with enameled finish.

E. Pipe Thread: ASME B1.20.1

F. Heating Element: Electric, replaceable, immersion type.

1. Temperature Control: Adjustable thermostat.

G. Anode Rod: Factory installed.

H. Drain Valve: ASSE 1005, corrosion-resistant metal, factory installed.

2.2 NON-ASME COMPRESSION TANKS

A. Description: Steel, pressure-rated tank constructed with welded joints and factory installed butyl-rubber diaphragm.

B. Manufacturers:

1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. State Industries.
4. Taco, Inc.

5. Wessels Co.
6. Zurn Industries, Inc.; Wilkins Div.

C. Diaphragm: Butyl-rubber FDA approved for use with potable (domestic) water

D. ASME-code label: No

E. Working Pressure: 150 psig.

F. Tappings: Factory-fabricated steel, welded to tank before testing and labeling.

G. Pipe Thread: ASME B1.20.1

H. Tank Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.

I. Tank Exterior Finish: Manufacturer's standard, unless indicated otherwise.

J. Air Pre Charge Valve: Factory installed Schrader type (standard tire valve).

2.3 WATER HEATER ACCESSORIES

A. Combination Temperature and Pressure Relief Valves: ASME rated, ASME stamped, and complying with ASME PTC 25.3.

1. Exception: Omit combination temperature and pressure relief valve for tankless water heater, and furnish pressure relief valve for installation in piping
2. Minimum Relieving Capacity: Equal to heat input.
3. Minimum Pressure Setting: Equal to water heater working pressure rating.
4. Sensing Element: Extends into tank.
5. Temperature Setting: 20° F Higher than water heater set point temp

B. Vacuum Relief Valves: Comply with ASME PTC 25.3. Furnish for installation in piping.

1. Exception: Omit if water heater has integral vacuum-relieving device.

C. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater plus four (4) inches, dimensions not less than two to four (2-4) inches vertical, and include drain outlet not less than NPS ¾ in diameter with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

D. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.

E. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

A. Install water heaters on housekeeping pads unless otherwise indicated.

B. Install water heaters, level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

C. Install temperature and pressure relief valves in top portion of storage tanks. Extend relief valve outlet with water piping in continuous downward pitch. Discharge in the following order:

1. Closest floor drain.
2. Mop sink.
3. Drain Pan.

D. Install vacuum relief valves in cold-water-inlet piping.

E. Install thermometers on outlet piping of water heaters. Comply with requirements for thermometers specified in Division 22 Section "Meters and Gages for Plumbing Piping."

F. Install pressure gauges on outlet piping of water heaters. Comply with requirements for pressure gauges specified in Division 22 Section "Meters and Gages for Plumbing Piping."

G. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks.

H. Fill water heaters with water.

I. Charge compression tanks to indicated pressure.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Division 22 Section "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. For water heaters in excess of 200 gallons or 40 kW Engage a factory-authorized service representative to perform startup service.

B. In addition to manufacturer's written installation and startup checks, perform the following:

1. Verify that piping system tests are complete.
2. Check for piping connection leaks.
3. Operate relief valve and confirm proper operation of relief valve, outlets, and drain piping.
4. Check operation of circulating pumps.
5. Energize electric circuits.
6. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
7. Adjust temperature settings to indicated temperature.

3.5 DEMONSTRATION

A. When a factory-authorized service representative is required to perform startup service engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water heaters.

1. Train Owner's maintenance personnel on procedures for starting and stopping, troubleshooting, servicing, and maintaining equipment.
2. Review data in maintenance manuals.

END OF SECTION 223300

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FRP: Fiberglass-reinforced plastic.

C. PMMA: Polymethyl methacrylate (acrylic) plastic.

D. PVC: Polyvinyl chloride plastic.

E. RFI:Request for information.

F. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

G. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

H. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

I. Fitting: Device that controls flow of water into or out of plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, showerheads and tub spouts, drains and tailpieces, and traps and waste pipes.

J. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

K. Other Manufacturers: Use one of those listed.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and security anchors for security plumbing fixtures.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Performance Submittals:

1. Product Data:
   a. Documentation indicating flow and water consumption requirements.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For security plumbing fixtures and components to include in maintenance manuals.

B. Faucet Cartridges, washers, aerators, and O-Rings: Equal to five percent (5%) of amount of each type and size installed but not less than two (2) of each type and size.

C. Flushometer Valve Repair Kits: Equal to ten percent (10%) of quantity of each type installed, or two (2), whichever is less.

D. Provide Minimum number of key operators (wrenches/tools) for loose key stops, wall hydrants, aerators, security fasteners and any fixture where a key, security fastener, or special tool is required:

1. One (1) for ten percent (10%) of each size or ten (10), whichever is less.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Electrical components, devices, and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities. Comply with requirements in Public Law 102-486, "Energy Policy Act," regarding water flow and consumption rates for plumbing fixtures.

D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

E. EPA WaterSense: Provide fixtures with WaterSense labeling for all applicable and eligible fixtures and accessories.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following standards and other requirements where applicable:

1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
3. Slip-Resistant Bathing Surfaces: ASTM F 462.
4. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
5. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
6. Stainless-Steel Residential Sinks: ASME A112.19.3.
7. Vitreous-China Fixtures: ASME A112.19.2M.
8. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
9. Water-Closet, Flushometer Tank Trim: ASSE 1037.
10. Whirlpool Bathtub Fittings: ASME A112.19.8M.

11. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
12. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
13. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
14. Faucets: ASME A112.18.1.
15. Hose-Connection Vacuum Breakers: ASSE 1011.
16. Hose-Coupling Threads: ASME B1.20.7.
17. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
18. NSF Potable-Water Materials: NSF 61.
19. Pipe Threads: ASME B1.20.1.
20. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
21. Supply Fittings: ASME A112.18.1.
22. Brass Waste Fittings: ASME A112.18.2.
23. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
24. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
25. Deck-Mounted Bath/Shower Transfer Valves: ASME 18.7.
26. Faucets: ASME A112.18.1.
27. Hand-Held Showers: ASSE 1014.
28. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
29. Hose-Coupling Threads: ASME B1.20.7.
30. Manual-Control Antiscald Faucets: ASTM F 444.
31. Pipe Threads: ASME B1.20.1.
32. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
33. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
34. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
35. Atmospheric Vacuum Breakers: ASSE 1001.
36. Brass and Copper Supplies: ASME A112.18.1.
37. Dishwasher Air-Gap Fittings: ASSE 1021.
38. Manual-Operation Flushometers: ASSE 1037.
39. Plastic Tubular Fittings: ASTM F 409.
40. Brass Waste Fittings: ASME A112.18.2.
41. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
42. Disposers: ASSE 1008 and UL 430.
43. Dishwasher Air-Gap Fittings: ASSE 1021.
44. Flexible Water Connectors: ASME A112.18.6.
45. Floor Drains: ASME A112.6.3.
46. Grab Bars: ASTM F 446.
47. Hose-Coupling Threads: ASME B1.20.7.
48. Hot-Water Dispensers: ASSE 1023 and UL 499.
49. Off-Floor Fixture Supports: ASME A112.6.1M.
50. Pipe Threads: ASME B1.20.1.
51. Plastic Shower Receptors: ANSI Z124.2.
52. Plastic Toilet Seats: ANSI Z124.5.
53. Supply and Drain Protective Shielding Guards: ICC A117.1.
54. Whirlpool Bathtub Equipment: UL 1795.

1.6 COORDINATION

A. Coordinate all accessories. Ensure items fit and work together as an assembly. Provide additional accessories to accommodate final installed field conditions; to include, but not limited to, offsets and other items required for ADA compliance. Provide necessary accessories and components for complete installation.

B. Coordinate roughing-in and final plumbing fixture locations and verify that fixtures can be installed to comply with design.

C. Model numbers are intended to identify families of fixtures and may be incomplete. Refer to other contract documents for hand.

D. Where fixtures or its associated components are installed in rated floors, walls, or ceilings; provide rated fixtures, accessories, and components of equal rating.

E. Where the flush valve assembly height would conflict with the rear grab bar installation (including the minimum 1-1/2" clearance to the bottom of the grab bar), the vacuum breaker flush tube shall be shortened. Shortening of the vacuum breaker flush tube shall not exceed the manufacturer's requirements for maintaining proper operation, including the CL (critical line) markings on the flush tube if provided by the manufacturer to indicate shortening limitations.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Cartridges, washers, aerators, and O-Rings: Equal to 5 percent of amount of each type and size installed but not less than 2 of each type and size.
2. Flushometer Valve, Repair Kits: 2 of each type.

PART 2 - PRODUCTS

2.1 (**LA-1**) COUNTER-MOUNTED LAVATORY (ACCESSIBLE) WITH MANUALLY-OPERATED FAUCET

A. Manufacturer & Model Number: American Standard 0476028.020

1. Material: Vitreous China
2. Color: White
3. With Overflow
4. 4" Centers
5. With Sealant
6. Self-Rimming

B. Faucet: Delta B510LF-PPU-ECO

1. 4" Spout with Angled Throw
2. 0.50 GPM (1.9 L/min.) Maximum Flow
3. Chrome Plated
4. All Brass Body
5. Renewable Seat and Washers

6. Wrist Blade Handles
7. Hot and Cold Indexes

C. Drain: McGuire Part Number 155A

D. Trap: McGuire Part Number 8902C-F

1. 1-1/4" x 1-1/2" cast brass polished chrome trap with cleanout plug and brass slip nuts.
2. 17-gauge seamless tubular chrome plated brass wall bend.
3. Forged brass chrome plated wall flange with setscrew.

E. Supplies: McGuire Part Number 2165-N3-F

1. ½" IPS x 3/8" OD
2. ½" x 3" chrome plated brass nipple.
3. Heavy brass chrome plated wall flange with set-screw
4. Contractor shall coordinate supply connection to faucet.

F. Insulation: Tru-Bro Lav Guard #102

1. Color: White
2. Insulate P-trap, hot and cold angle valves, hot and cold risers.

G. Other Manufacturers: Provide products, features, and accessories equal to those specified above.

1. Lavatory:
   a. American Standard
   b. Eljer
   c. Kohler
   d. Sloan
   e. Zurn

2. Faucet:
   a. Cambridge Brass
   b. Chicago
   c. Delta
   d. Moen
   e. Speakman
   f. T&S Brass
   g. Zurn

3. Drain:
   a. Kohler
   b. Cambridge Brass
   c. Chicago

4. Trap:
   a. Kohler
   b. Cambridge Brass

5. Supplies:
   a. Cambridge Brass
   b. Kohler

6. Insulation:
   a. McGuire

2.2 (**SK-1**) WALL-MOUNTED SINK (ACCESSIBLE) WITH MANUALLY-OPERATED FAUCET

A. Manufacturer & Model Number: Zurn Z5340

1. Material: Vitreous China
2. Color: White

B. Faucet: Moen M-DURA 8215F05

1. 4" Spout with Angled Throw
2. 0.50 GPM (1.90 L/min.) Maximum Flow
3. Chrome Plated
4. All Brass Body
5. Renewable Seat and Washers
6. Wrist Blade Handles
7. Hot and Cold Indexes

C. Drain: McGuire Part Number 155A

D. Trap: McGuire Part Number 8902C-F

1. 1-1/4" x 1-1/2" cast brass polished chrome trap with cleanout plug and brass slip nuts.
2. 17-gauge seamless tubular chrome plated brass wall bend.
3. Forged brass chrome plated wall flange with setscrew.

E. Supplies: McGuire Part Number 2165-N3-F

1. ½" IPS x 3/8" OD
2. ½" x 3" chrome plated brass nipple.
3. Heavy brass chrome plated wall flange with set-screw
4. Contractor shall coordinate supply connection to faucet.

F. Insulation: Tru-Bro Lav Guard #102

1. Color: White
2. Insulate P-trap, hot and cold angle valves, hot and cold risers.

G. Carrier: Josam Series 17100

1. Floor mounted with rectangular uprights.

H. Other Manufacturers: Provide products, features, and accessories equal to those specified above.

1. Lavatory:
   a. American Standard
   b. Eljer
   c. Kohler
   d. Sloan
   e. Zurn

2. Faucet:
   a. Cambridge Brass
   b. Chicago

c. Delta
d. Moen
e. Speakman
f. T&S Brass
g. Zurn

3. Drain:
   a. Kohler
   b. Cambridge Brass
   c. Chicago

4. Trap:
   a. Kohler
   b. Cambridge Brass

5. Supplies:
   a. Cambridge Brass
   b. Kohler

6. Insulation:
   a. McGuire

7. Carrier:
   a. JR Smith

2.3 (**UR-1**) URINAL) WITH MANUALLY-OPERATED DIAPHRAM-TYPE FLUSH VALVE

A. Manufacturer & Model Number: Kohler K-4991-ET-0 (0.125 Gallon Per Flush)

1. Material: Vitreous China
2. Color: White
3. Mounting Height: Rim at 24" above finished floor

B. Flush Valve: Sloan Regal Model 186-0.125 (0.125 Gallon Per Flush)

1. Supply Rough-in Elevation: 11-1/2" above spud connection.
2. Provide:
   a. Accessible handle located on wide side of approach.
   b. Sweat Solder Adapter and Cast Wall Flange with Set Screw.
   c. Vandal Resistant Stop Cap with Set Screw.

C. Carrier: Josam Series 17560-UR.

1. Options
   a. Provide components for thicker walls when required.
   b. Provide valve plate for attaching to upright.

D. Other Manufacturers: Provide products, features, and accessories equal to those specified above.

1. Urinal:
   a. American Standard
   b. Crane
   c. Eljer

d. Gerber
e. Kohler
f. Sloan
g. Zurn

2. Flush Valve:
a. American Standard
b. Delany
c. Moen
d. Sloan
e. Zurn

2.4 (**UR-2**) URINAL (ACCESSIBLE) WITH MANUALLY-OPERATED DIAPHRAM-TYPE FLUSH VALVE

A. Manufacturer & Model Number: Kohler K-4991-ET-0 (0.125 Gallon Per Flush)

1. Material: Vitreous China
2. Color: White
3. Mounting Height: Rim at 17" above finished floor

B. Flush Valve: Sloan Model 186-0.125 (0.125 Gallon Per Flush)

1. Supply Rough-in Elevation: 11-1/2" above spud connection.
2. Provide:
a. Accessible handle located on wide side of approach.
b. Sweat Solder Adapter and Cast Wall Flange with Set Screw.
c. Vandal Resistant Stop Cap with Set Screw.

C. Carrier: Josam Series 17560-UR.

1. Options
a. Provide components for thicker walls when required.
b. Provide valve plate for attaching to upright.

D. Other Manufacturers: Provide products, features, and accessories equal to those specified above.

1. Urinal:
a. American Standard
b. Crane
c. Eljer
d. Gerber
e. Kohler
f. Sloan
g. Zurn

2. Flush Valve:
a. American Standard
b. Delany
c. Moen
d. Sloan
e. Zurn

2.5 (**WB-1**) WASHER BOX CONNECTION

A. General: Recessed-mounting, reversible, metal washing machine outlet box with ½" IPS or copper sweat supply fittings complying with ASME A112.18.1M. Include box with faceplate, services indicated for equipment connections, and reinforcement.

B. Manufacturer: Oatey Quadro 1/4 Turn - 38541

1. ¼" turn ball valves
2. Long shank adapters
3. 2" drain
4. Integral Water hammer arrestors

C. Available Manufacturers:

1. Acorn Engineering Company.
2. IPS Corporation, Guy Gray
3. Oatey.
4. Symmons Industries, Inc.
5. Zurn Industries, Inc.; Jonespec Div.

2.6 (**WC-1**) WALL-MOUNTED WATER CLOSET WITH MANUALLY-OPERATED DIAPHRAM-TYPE FLUSH VALVE

A. Manufacturer & Model Number: Kohler K-84325-0 (1.28 Gallon Per Flush)

1. Material: Vitreous China
2. Color: White

B. Fixture Carrier: Select Josam, Smith or other manufacturer's fixture carrier to suit installation in terms of clear space available in the chase, waste pipe configuration, and waste piping location.

C. Flush Valve: Sloan Royal Model 111 (1.28 Gallon Per Flush)

1. Supply Rough-in Elevation: 11-1/2" above spud connection.
2. Provide:
   a. Accessible handle located on wide side of approach.
   b. Sweat Solder Adapter and Cast Wall Flange with Set Screw.

D. Seat: Church 9500SSCT (White)

1. Elongated extra heavy weight seat with stainless steel self-sustaining check hinge.

E. Manufacturers:

1. Water Closet:
   a. American Standard
   b. Crane
   c. Eljer
   d. Gerber
   e. Kohler
   f. Sloan
   g. Zurn

2. Flush Valve:
   a. American Standard

b. Delany
c. Moen
d. Sloan
e. Zurn

3. Seat:
a. Bemis
b. Centoco
c. Church
d. Olsonite

2.7 (**WC-2**) WALL-MOUNTED WATER CLOSET (ACCESSIBLE) WITH MANUALLY-OPEARTED DIAPHRAM-TYPE FLUSH VALVE

A. Manufacturer & Model Number: Kohler K-84325-0 (Wall Mounted 1.28 Gallon Per Flush)

1. Material: Vitreous China
2. Color: White
3. Mounted at ADA height.

B. Fixture Carrier: Select Josam, Smith or other manufacturer's fixture carrier to suit installation in terms of clear space available in the chase, waste pipe configuration, and waste piping location.

C. Flush Valve: Sloan Royal Model 111 (1.28 Gallon Per Flush)

1. Supply Rough-in Elevation: 11-1/2" above spud connection.
2. Provide:
a. Accessible handle located on wide side of approach.
b. Sweat Solder Adapter and Cast Wall Flange with Set Screw.

D. Seat: Church 9500SSCT (White)

1. Elongated extra heavy weight seat with stainless steel self-sustaining check hinge.

E. Manufacturers:

1. Water Closet:
a. American Standard
b. Crane
c. Eljer
d. Gerber
e. Kohler
f. Sloan
g. Zurn

2. Flush Valve:
a. American Standard
b. Delany
c. Moen
d. Sloan
e. Zurn

3. Seat:

a. Bemis
b. Centoco
c. Church
d. Olsonite

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water soil and for waste piping systems and supports to verify actual locations and sizes of piping connections and that locations and types of supports match those indicated, before plumbing fixture installation. Manufacturer's roughing-in data overrides all other indicated data.

B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.

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

3.2 FIXTURE INSTALLATION

A. Assemble fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. For wall-hanging fixtures, install off-floor supports affixed to building substrate.

C. Install back-outlet, wall hanging fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-hanging fixtures with tubular waste piping attached to supports.

F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.

G. Install counter-mounted fixtures in and attached to casework.

H. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.

I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Use ball valve if stops are not specified with fixture. Refer to Section "Valves".

J. Install trap and waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

K. Install waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

L. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

M. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

N. Install toilet seats on water closets.

O. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

P. Install water supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.

Q. Install faucet, flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

R. Install shower, flow-control fittings with specified maximum flow rates in shower arms.

S. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

T. Install disposer in outlet of sinks indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.

U. Install hot-water dispensers in back top surface of sink or in counter with spout over sink.

V. Install escutcheons at piping wall-ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Refer to Division 22 Section "Common Work Results For Plumbing" for escutcheons.

W. Set service basins in leveling bed of cement grout. Refer to Division 22 Section "Common Work Results For Plumbing" for grout.

X. Refer to Section "Joint Sealants" for sealant and installation requirements.

Y. Provide connection to automatic lavatories & flush valves as required via low-voltage transformer(s). Mount transformer(s) above accessible ceiling. Connect to local 120V receptacle circuit with disconnect switch adjacent to transformer. All circuitry (including low voltage) shall be run concealed & in conduit. Coordinate connection requirements.

Z. Shutoff valves shall be provided and located on each floor, on takeoffs from all vertical risers, branch lines from the mains, and at the branch connections to each fixture.

3.3 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect water supplies from water distribution piping to fixtures.

C. Connect drain piping from fixtures to drainage piping.

D. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use sizes required to match fixtures. Connect to plumbing piping.

E. Supply and Waste Connections to Fixtures and Equipment Specified in Other Sections: Connect fixtures and equipment with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.

F. Ground equipment: Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Verify that installed fixtures are categories and types specified for locations where installed.

B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

E. Install fresh batteries in sensor-operated mechanisms.

3.5 ADJUSTING

A. Replace washers and seals or cartridges of leaking and dripping faucets, stops, and valves.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
2. Remove sediment and debris from drains.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

1.4 QUALITY ASSURANCE

A. Equipment and appliances comprising portions of the mechanical systems regulated by the applicable building codes shall be listed and labeled in accordance with the current edition of those codes.

B. Equipment and appliances comprising portions of the mechanical systems shall be installed in accordance with the listing, manufacturer's installation instructions, and the applicable building codes. Manufacturer's installation instructions shall be available on the job site for use and inspection.

C. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

D. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

E. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.6 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.7 INTENT OF CONTRACT DOCUMENTS

A. Mechanical and HVAC drawings are diagrammatic, indicating general locations and arrangements of pipe, duct, and equipment. Not necessarily indicating all offsets, conditions, and appurtenances required to provide clearances for maximum practical accessibility to perform maintenance.

B. Coordinate work in order to achieve proper operation and to provide a maintainable installed condition.

C. Notify the Architect's representative immediately of conditions which do not comply or will not produce this result.

D. Indicated configurations were used to size pipes, pumps, expansion tanks and other devices. Install piping, duct, and equipment generally as indicated. Minor deviations are permitted in the course of necessary coordination. Major changes shall be submitted for approval by the Architect's representative. Additional fittings and offsets not indicated are expected, anticipated by the design, and shall be provided. If more than 5% of the indicated number of fittings are required or if one change in direction is within six inches of another change in direction and this "Z" shape is not indicated notify the Architect's representative immediately. Provide necessary additional fittings and offsets. Changes in pipe size shall be made only with written approval from the Architect's representative.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Refer to Section "Hydronic Piping" for additional pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

A. Refer to individual Division 23 piping sections for joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions inside & outside pipe and:

1. ASME B16.21, non-metallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is otherwise indicated.

   a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated, and full-face or ring type, unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free (95% Tin, 5% Antimony) alloy. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg-5, silver alloy for refrigerant piping, unless otherwise indicated.

E. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.3 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Plastic. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PE: Reusable, PE, tapered cup-shaped and smooth-outer surface with nailing flange for attaching to wooden forms.

2.5 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated.

E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.6 GROUT

A. Description: ASTM C 1107, Grade B, non-shrink and non-metallic, dry hydraulic cement grout.

1. Characteristics: Post-hardening, volume-adjusting, non-staining, non-corrosive, non-gaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following and Division 23 Sections specifying piping systems.

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.

D. Install piping above accessible ceilings allowing sufficient space for ceiling panel removal.

E. Install piping to permit valve operation & servicing.

F. Install condensate drain piping at 1% slope.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections unless otherwise indicated.

I. Install piping leaving room for installation of insulation.

J. Install system components with pressure rating equal to or greater than system operating pressure.

K. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. Exposed, Interior Installations/Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
2. Exposed, Interior Installations/Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish and set-screw.
3. Exposed, Interior Installations/Insulated Piping: One-piece, cast-brass type with polished chrome-plated finish.
4. Exposed, Interior Installations/Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with finish to match surrounding surfaces.
5. Exposed, Interior Installations/Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with finish to match surrounding surfaces.
6. Exposed, Interior Installations/Piping in Unfinished Service Spaces: None, provide sealant.
7. Exposed, Interior Installations/Piping in Equipment Rooms: None, provide sealant.
8. Exposed, Interior Installations/Piping at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces: None - provide sealant and sleeve extending 2" above floor to prevent liquid leaking to floor below.

L. Provide seal around piping penetrations of full height interior walls, both rated and non-rated, that occur above ceilings. Refer to Section 079200 Joint Sealants.

M. Sleeves are not required for core-drilled holes.
1. Exception: Exposed, Interior Installations at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.
1. Exception: Exposed, Interior Installations at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces.

O. Install sleeves for pipes passing through walls, floors, or roofs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment rooms, fan rooms or other similar wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring.

2. Install sleeves as walls and slabs are constructed.

a. PVC Pipe Sleeves: Permitted for pipes smaller than 6" except aboveground, exterior-walls.
b. Steel Sheet Sleeves: Permitted for pipes 6" and larger, penetrating gypsum-board partitions except aboveground, exterior-walls.
c. Seal space outside sleeve fittings with grout and sealant.

3. Except for penetrations where mechanical sleeve seals are used, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Section "Joint Sealants".

P. Aboveground Exterior Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for annular clear space required by the mechanical sleeve seal manufacturer between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
4. Sleeves from an approved sleeve seal manufacturer shall be acceptable.

Q. Underground Exterior Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for annular clear space required by the mechanical sleeve seal manufacturer between pipe and sleeve for installing mechanical sleeve seals.

R. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Section "Penetration Firestopping" for materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply water-flushable flux, unless otherwise indicated, to tube end. Construct joints using lead-free solder alloy.

E. Brazed Joints: Construct joints using copper-phosphorus brazing filler metal.

F. Threaded Joints: Thread pipe with tapered pipe threads. 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 otherwise indicated.

G. Welded Joints: Construct joints using qualified processes and welding operators.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Mechanical Joints: Prepare pipe ends and fittings, apply coupling, and join according to joint manufacturer's written instructions.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping 2" and smaller, one adjacent to each valve and at final connections to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2" and larger, adjacent to final connections to each piece of equipment.
3. Install dielectric unions or flanges for connections of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to service side of equipment.

D. Install equipment to allow space for other systems.

3.5 PAINTING

A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 HOUSEKEEPING PADS AND EQUIPMENT PADS

A. Housekeeping pads and equipment pads: Anchor equipment to concrete according to equipment manufacturer's written instructions and according to seismic codes at project location.

1. Construct concrete pads in accordance with drawing details.
2. Details may be found on structural drawings. If details are not provided comply with the following:
    a. Housekeeping pads inside the building shall be 6" thick and 6" larger all around than supported equipment. Provide #4 rebar at 12" on center each way at mid-depth of slab. Provide a 3/4" chamfer on all edges.
    b. Equipment pads outside the building shall be 8" thick with a 12" deep and 20" wide turndown (footing) all around the outside edge of the pad. Provide #5 rebar at 16" on center each way at mid-depth of slab. Pad shall be 6" larger all around than supported equipment.
    c. Install epoxy-coated anchor bolts. For equipment on housekeeping pads bolts shall extend through housekeeping pad, and anchor into structural concrete floor.
    d. Place and secure anchor bolts using supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions for placement.
    e. Install anchor bolts to elevations required for proper attachment to supported equipment.
    f. Install anchor bolts according to anchor bolt manufacturer's written instructions.
    g. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Section "Cast-in-Place Concrete".

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.9 EXCAVATION AND BACKFILL

A. Excavation and backfill shall be as indicated in Division 1 specifications and on the drawings. If excavation and backfill is not otherwise indicated the following shall apply:
   1. Excavate trenches to indicated gradients, lines, depths, and elevations.
      a. Beyond the building perimeter, excavate trenches to allow installation of top of pipe below frost line.
   2. Excavate trenches to uniform widths to provide twelve inches clear on each side of pipe. Excavate trench walls vertically from trench bottom.
   3. Trench Bottoms: Excavate trench bottoms to provide flat surface. Place and compact six inches of sand. Excavate and shape sand to provide uniform bearing and support of pipes. Shape sand to provide continuous support for bells, joints, fittings, and barrels of pipes. Sand shall be free of projecting stones and sharp objects.
   4. Backfill and hand tamp to 95% proctor to six inches above the top of the pipe.
   5. Backfill and machine tamp the remainder of the trench to 95% proctor in twelve inch lifts.

END OF SECTION 230500

SECTION 230513 – MOTORS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

A. Manufacturer's catalog and efficiency data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.4 COORDINATION

A. All motors are required to be equipped with overload protection located near the motor.

1. Overload protection shall:

   a. Be located between the circuit breaker or fuse provided under Division 26 and the motor windings.
   b. Meet one of the options specified in the following paragraph.

2. Overload protection may be:

   a. Located in the motor installed by the motor manufacturer. (preferred)
   b. A separate device located near the motor.
   c. Located in, or with, a disconnect switch provided by the equipment manufacturer. Provision of this switch shall not modify, change, or eliminate any Division 26 requirement. This means some equipment shall be provided or specified with two disconnecting means.

B. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:

1. Compatible with controller
2. Matched to torque and horsepower requirements of the load.
3. Matched to ratings and characteristics of supply circuit and required control sequence.

C. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.

D. Belt tension must be wrench and socket adjustable.

E. Belt tensioning device must accommodate adjustable sheaves.

PART 2 - PRODUCTS

2.1 MOTOR REQUIREMENTS

A. Motor requirements apply except as follows:

1. Ratings, performance, or characteristics for a motor are specified in another Section or are scheduled on the drawings.

2. Motor manufacturer requires ratings, performance, or characteristics, other than those specified to meet indicated performance.

2.2 MOTOR CHARACTERISTICS

A. Frequency Rating: 60 Hz.

B. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.

C. Duty: Continuous at 105 deg F and 3300 feet above sea level.

D. Capacity and Torque sufficient to:

1. Start, accelerate, and operate connected load.

2. Maintain designated speeds.

3. Operate at installed altitude and environment.

4. Operate with indicated operating sequence.

5. Operate without exceeding nameplate ratings.

6. Operate without utilizing service factor.

E. Enclosure: Open drip-proof unless otherwise indicated.

F. Minimum Service Factor: 1.15 unless otherwise indicated.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. NEMA Premium efficiency motors shall meet the following full load efficiency:

HP	ODP			TEFC		
	6 Pole	4 Pole	2 Pole	6 Pole	4 Pole	2 Pole
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7

40	94.1	94.1	92.4	94.1	94.1	92.4
50	94.1	94.5	93.0	94.1	94.5	93.0
60	94.5	95.0	93.6	94.5	95.0	93.6
75	94.5	95.0	93.6	94.5	95.4	93.6
100	95.0	95.4	93.6	95.0	95.4	94.1
125	95.0	95.4	94.1	95.0	95.4	95.0
150	95.4	95.8	94.1	95.8	95.8	95.0

C. Efficiency: NEMA Premium

D. Stator: Copper windings, unless otherwise indicated.

E. Rotor: Squirrel cage, unless otherwise indicated.

F. Bearings: Double-shielded, pre-lubricated ball bearings suitable for radial and thrust loading.

   a. For motors 100 HP or greater, bearings shall be ceramic.

G. Temperature Rise: Match insulation rating, unless otherwise indicated.

H. Insulation: Class F, unless otherwise indicated.

I. Code Letter Designation: NEMA starting Code F or G.

J. Enclosure: Cast iron.

K. Finish: Gray enamel.

L. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

M. Motors Used with Variable Speed Drives: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

   1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.

   2. Premium Efficiency Motors: Class B temperature rise, Class F insulation.

   3. Inverter-Duty Motors: Class F temperature rise, Class H insulation.

   4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally-protected motors.

   5. Shaft Grounding: Provide AEGIS bearing protection ring or approved equal.

      a. All motors operated on variable frequency drives shall be equipped with a maintenance free, conductive micro fiber, shaft grounding ring with a minimum of two rows of circumferential micro fibers to discharge electrical shaft currents within the motor and/or its bearings.
      b. Motors up to 100 HP shall be provided with a minimum of one shaft grounding ring installed either on the drive end or non-drive end. Motors over 100 HP shall be provided with an insulated bearing on the non-drive end and a shaft grounding ring on the drive end of the motor.
      c. Grounding rings shall be provided and installed by the motor manufacturer in accordance with the shaft grounding ring manufacturer's recommendations.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Perform the following:

1. Run each motor with its controller at load.
2. Demonstrate correct rotation, alignment, and speed.
3. Test interlocks and control features for proper operation.
4. Verify that current in each phase is within nameplate rating.
5. Verify RPM is in accordance with nameplate.
6. Where a generator is provided, run each motor on the generator with its controller and load. Demonstrate correct rotation, alignment, and speed.

3.2 ADJUSTING

A. Align motors, bases, and shafts.

3.3 CLEANING

A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

END OF SECTION 230513

SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 SLEEVE-SEAL SYSTEMS

A. Available Manufacturers:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Link Seal
4. Metraflex Company (The).
5. Pipeline Seal and Insulator, Inc.
6. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM or Nitrile rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Stainless steel.

3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.
    a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide ¼" clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants.

E. Fire Ratings: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide ¼" clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Division 07 Section "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire Rating: Maintain indicated fire rating at pipe penetrations. Seal pipe penetrations with firestop materials.

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building unless otherwise indicated. They are not required at sanitary and storm piping exits unless otherwise indicated.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade, below Grade, Concrete Slabs-on-Grade, and Concrete Slabs above Grade:
    a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.
        1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
    b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.

END OF SECTION 230517

SECTION 230523 – GENERAL DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

A. The following are standard abbreviations for valves:
1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. MPTFE: Modified polytetrafluoroethylene plastic.
4. NBR: Acrylonitrile-butadiene rubber.
5. PTFE: Polytetrafluoroethylene plastic.
6. RPTFE: Reinforced polytetrafluoroethylene plastic.
7. SWP: Steam working pressure.
8. TFE: Tetrafluoroethylene plastic.
9. WOG: Water Oil Gas.

1.3 SUBMITTALS

A. Product Data: For each type of valve proposed. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include proposed specialties and accessories.

1.4 QUALITY ASSURANCE

A. ASME Compliance: ASME B31.1 for power piping valves and ASME B31.9 for building services piping valves.
1. Exceptions: Domestic hot- and cold-water valves unless referenced.

B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.5 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 ball valves open to minimize exposure of functional surfaces.

4. Set butterfly valves closed or slightly open.
5. Block check valves in either closed or open position.

B. Use the following precautions during storage:
1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 VALVES, GENERAL

A. Refer to Part 3 "Valve Applications" Article for applications of valves.

B. Bronze & Brass: Shall be dezincification resistant. (Zinc content shall be less than 15%)

C. Bronze Valves: 2" and smaller with threaded ends, unless otherwise indicated.

D. Ferrous Valves: 2-1/2" and larger with flanged ends, unless otherwise indicated.

E. Valve Pressure and Temperature Ratings: Not less than indicated for system pressure and temperature.

F. Valve Sizes: Same as the larger of the upstream or downstream pipe, unless otherwise indicated.

G. Valve Actuators:
1. As indicated in other Part 2 articles.
2. Where indicated, provide a chain actuator.
3. Chain Actuator: For attachment to valves of size and mounting height indicated.
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.

H. Extended Valve Stems: Provide on insulated valves.

I. Valve Flanges: Provide ASME B16.1 for cast-iron valves, ASME B16.5 for steel, and ASME B16.24 for bronze.

J. Valve Grooved Ends: AWWA C606.

K. Threaded: With threads according to ASME B1.20.1.

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

2.2 COPPER-ALLOY BALL VALVES

A. Two-Piece, Copper-Alloy Ball Valves (Full Port):
1. Conbraco Industries-Apollo 77C-140 Series with stainless steel ball & stem (Un-insulated piping)
2. Conbraco Industries-Apollo 77C-140 Series with stainless steel ball & stem. Provide 2 ¼" stem extension (Insulated piping)
3. Other Manufacturers:
   a. Milwaukee
   b. Watts
   c. Nibco
4. Handle Nut: Zinc plated steel or 300 series stainless steel.
5. Handle: Zinc plated steel, clear chromate plastic, or vinyl coated.
6. Threaded Pack Gland: Brass ASTM B-16 Alloy 360
7. Packing: MPTFE or TFE
8. Stem (Blowout Proof): ASTM A-276 type 316 stainless steel. Provide 2 ¼" stem extension for Insulated piping.
9. Thrust Washer: MPTFE or RPTFE
10. Ball: Full-port, ASTM A-276 Type 316 stainless steel.
11. Seats: MPTFE or Reinforced TFE
12. Body: Bronze ASTM B-584 for solder or threaded connection.
13. Body End Piece: Bronze ASTM B-584 for solder or threaded connection.
14. Rating: 150 psig saturated steam, 600 psig non-shock cold water, oil, and gas.
15. Conform To: MSS SP-110

B. Two-Piece, Copper-Alloy Ball Valves (Standard Port):
1. Conbraco Industries - Apollo 70 series with stainless steel ball & stem (Un-insulated piping)
2. Conbraco Industries - Apollo 70 series with stainless steel ball & stem. Provide 2 ¼" stem extension (Insulated piping)
3. Other Manufacturers:
   a. Milwaukee
   b. Watts
   c. Nibco.
4. Handle Nut: Zinc plated steel or 300 series stainless steel.
5. Handle: Zinc plated steel, clear chromate plastic, or vinyl coated.
6. Threaded Pack Gland: Brass ASTM B-16 Alloy 360
7. Packing: RPTFE or TFE
8. Stem (Blowout Proof): ASTM A-276 type 316 stainless steel. Provide 2 ¼" stem extension for Insulated piping.
9. Thrust Washer: MPTFE or Reinforced TFE
10. Ball: Full-port, ASTM A-276 Type 316 stainless steel.
11. Seats: MPTFE or Reinforced TFE
12. Body: Bronze ASTM B-584 for solder or threaded connection.
13. Body End Piece: Bronze ASTM B-584 for solder or threaded connection.
14. Rating: 150 psig saturated steam, 600 psig non-shock cold water, oil, and gas.
15. Conform To: MSS SP-110

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully- pen to fully-closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where indicated.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chainwheels on operators for ball and butterfly valves 4" and larger and more than 96 inches above finished floor. Extend chains to 60 inches above finished floor.

F. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
   3. Lift Check Valves: With stem upright and plumb.

G. Where applicable, install an isolation valve on supply and return piping at each branch from a vertical riser to each floor served. Locate floor isolation valves in an accessible location. Multiple sets on one floor may be required to provide accessibility.

3.3 ADJUSTING

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

3.4 VALVE APPLICATIONS

A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball or butterfly valves.
   2. Throttling Service: Ball or butterfly valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

C. Blow down valve serving sediment chamber of solids separator:
   1. Erosion resistant ball valve.

D. Chilled-Water, Heating Hot Water, Condenser Water, and Heat Pump Loop Piping (Use the following types of valves):
   1. Valves, NPS 2" and Smaller: Two-Piece, Copper-Alloy Ball Valves (Full Port).
   2. Valves, NPS 2-1/2" and 3":
      a. Two-piece or three-piece, Copper-Alloy Ball Valves (Full Port).
      b. Wafer-Lug, grooved-end, or flanged butterfly valves.
   3. Valves, NPS 4" and Larger: Wafer-Lug, grooved-end, or flanged butterfly valves.
   4. Pump Discharge Check Valves (Horizontal or Vertical), NPS 2" and Smaller: Bronze, Inline Spring Loaded Check Valves or triple duty valve.
   5. Horizontal Check Valves, NPS 2" and Smaller: Bronze, Horizontal Swing Check Valves.
   6. Vertical Check Valves, NPS 2" and Smaller: Bronze, Inline Lift Check Valves.
   7. Pump Discharge Check Valves (Horizontal or Vertical), NPS 2-1/2" and Larger: Grooved-End, Ductile-Iron Spring Assisted Check Valves, Spring Actuated Silent Check Valves, or triple duty valve.
   8. Horizontal Check Valves, NPS 2-1/2" and Larger: Bronze, Horizontal Swing Check Valves.
   9. Vertical Check Valves, NPS 2-1/2" and Larger: Grooved-End, Ductile-Iron Spring Assisted Check Valves or Spring Actuated Silent Check Valves.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

B. Terminology as defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

A. Design Requirement: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer where using methods other than indicated.

B. 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. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test medium.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following and include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

1.5 QUALITY ASSURANCE

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

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: 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.

2.2 TRAPEZE PIPE HANGERS

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

B. Trapeze Pipe Hanger Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.

1. Assemble and provide according to manufacturer's written instructions. Center piping on channel to evenly distribute load.

2. Pipe sizes and numbers shall be in accordance with the following:

TRAPEZE PIPE HANGER TABLE								
PIPE SIZE	**4”**	**3”**	**2 ½”**	**2”**	**1 ½”**	**1 ¼”**	**1”**	**TOTAL # of PIPES**

NUMBER OF PIPES PERMITTED IN ONE CHANNEL SUPPORT	**2**	0	0	0	0	0	0	**2**
	0	**2**	**2**	0	0	0	0	**4**
	0	**2**	0	**4**	0	0	0	**6**
	0	**2**	0	0	**6**	0	0	**8**
	0	0	**4**	**2**	0	0	0	**6**
	0	0	**4**	0	**2**	**2**	0	**8**
	0	0	**4**	0	0	**8**	0	**12**
	0	0	0	**6**	**2**	**2**	**2**	**12**
	0	0	0	**8**	0	**2**	0	**10**
	0	0	0	0	**14**	0	0	**14**
	0	0	0	0	0	**16**	0	**16**

Notes:

1. Piping larger than 4" in diameter is not permitted in a channel support system.
2. Channel support systems shall be limited to eight (8) pipes per channel and two (2) channels (levels) per support system.
3. Smaller pipes can be substituted for larger pipes. For example two ¾" pipes may be installed in lieu of two 1" pipes, or 2" in lieu of 3", etc.
4. Spacing shall be in accordance with requirements for the smallest supported pipe. Refer to other specification sections for spacing requirements. If spacing requirements are not indicated comply with MSS SP-69.

C. Metal Framing Systems:

1. Available Manufacturers:
   a. Anvil International; a subsidiary of Mueller Water Products Inc.
   b. Empire Industries, Inc.
   c. ERICO International Corporation.
   d. Haydon Corporation; H-Strut Division.
   e. NIBCO INC.
   f. PHD Manufacturing, Inc.
   g. PHS Industries, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

7. Coating: Zinc.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Available Manufacturers:

1. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.
9. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig, ASTM C 552, Type II cellular glass with 100-psig, or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

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" beyond sheet metal shield for piping operating below ambient air temperature.

2.4 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

1. Available Manufacturers:

a. Cooper B-Line – Dura-Blok
b. MAPA Products
c. Mifab, Inc. – C-Port
d. Miro Industries, Inc.
e. OMG, Inc.
f. PHP Systems/Design
g. Pipe Prop
h. Roof Top Blox
i. Rooftop Support Systems – Eberl Iron Works, Inc.

2. Provide pipe supports for supporting gas, condensate, refrigeration lines, or hydronic piping on flat roof surfaces. Support shall rest on roof surface without penetrating the

roof surface. Supports for condensate piping shall be adjustable vertically to ensure pipe slopes as required.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Curb Mounted Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.5 EQUIPMENT SUPPORTS/RAILS

A. Description: Welded, shop or field fabricated equipment support made from structural carbon-steel shapes unless indicated otherwise.

1. Available Manufacturers:
    a. Curbs Plus, Inc. – CPES-X
    b. Kees – Equipment Support Model SF
    c. Pate Company – Equipment Support ES-2
    d. Portals Plus – ER-2A
    e. Roof Products and Systems – Equipment Rails ER-2B
    f. Thybar Corporation – TEMS 3
2. Construction:
    a. Minimum 18 gauge, G90 galvanized steel. Fully mitered and welded corners. Integral base plate. 3" Cant style support. All welds prime painted after fabrication. Full-depth internal C-channel reinforcing on 12" centers and 6" spreader channels on alternating 12" centers. 18 Gauge counterflashing factory-installed with tek-screws and neoprene washers. Factory-installed 2'x4" pressure-treated wood nailer.
    b. Minimum height of 12" above finished roof or as noted.

2.6 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

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Provide 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, MSS SP-89, and Table above. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Provide in pipe hanger or shield for insulated piping.

E. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Section "Roof Accessories" for curbs.

F. Provide 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.

- Provide 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.

- Provide lateral bracing with pipe hangers and supports to prevent swaying.

H. Provide building attachments within concrete slabs or attach to structural steel. Building attachments may not used on steel joists unless otherwise indicated. Provide additional attachments at concentrated loads, including valves, flanges, and strainers, 2-1/2" and larger and at changes in direction of piping. Provide concrete inserts before concrete is placed; fasten inserts to forms and provide reinforcing bars through openings at top of inserts.

I. Load Distribution: Provide hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

J. Pipe Slopes: Provide hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

K. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Provide thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Provide MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

3. Provide MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

4. Shield Dimensions for Pipe: Not less than the following:

    a. Pipe ¼" to 3-½": 12 inches long and 0.048 inch thick.
    b. Pipe 4": 12 inches long and 0.06 inch thick.
    c. Pipe 5" and 6": 18 inches long and 0.06 inch thick.
    d. Pipe 8" to 14": 24 inches long and 0.075 inch thick.

5. Pipes 8" and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

6. Thermal-Hanger Shields: Provide with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 ROOF EQUIPMENT SUPPORTS

A. Equipment supports must span a minimum of two structural roof members.

B. No load shall be applied to a cantilever exceeding 12" in length.

C. Fasten base flange to roof steel or deck with stitch weld or mechanical fastener not exceeding 18" on center in accordance with NRCA specifications.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/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. Provide 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.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

A. Touchup: Unless otherwise indicated clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Provide same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and immediately apply galvanizing-repair paint. Paint shall comply with ASTM A 780.

3.7 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Provide hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Provide nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Provide copper-plated pipe hangers and copper attachments for copper piping and tubing.

F. Provide padded hangers for piping that is subject to scratching.

G. Provide thermal-hanger shield inserts for insulated piping and tubing.

H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated provide the following:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of stationary pipes ½" to 30".
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes 4" to 14", requiring up to 4" of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes ¾" to 14", requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes ½" to 14" if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes ½" to 4", to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes ¾" to 8".
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes ½" to 8".
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes ½" to 8".
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes ½" to 8".
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes ½" to 8".
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS ½" to 3".
12. U-Bolts (MSS Type 24): For support of heavy pipes ½" to 14".
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes 4" to 14", with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes 4" to 14", with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes 2-½" to 14" if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes 1" to 14", from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes 2-½" to 14", from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes 2" to 14" if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes 2" to 14" if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes 2" to 14"if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

I. Vertical-Piping Clamps: Unless otherwise indicated provide the following:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers ¾" to 14".
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers ¾" to 14" if longer ends are required for riser clamps.

J. Hanger-Rod Attachments: Unless otherwise indicated provide the following:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
6. Flat Plate, Double Nut, and Washer as Detailed on Structural Drawings: For attaching to bar joists. Method of attachment to bar joists must be approved by the structural engineer and joist manufacturer.

K. Building Attachments: Unless otherwise indicated provide the following:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Flat Plate, Double Nuts, and Washer as Detailed on Structural Drawings: For use under roof installations with bar-joist construction to attach to bottom chord of joist.
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 steel I-beams. Only allowed for open web joists if load does not exceed 50 lbs.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Provide 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.
16. For sloping structure, provide clamp with swivel such that required threaded rod is vertical. Bending of threaded rod is not acceptable.

L. Saddles and Shields: Unless otherwise indicated provide the followings:

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.

M. Spring Hangers and Supports: Unless otherwise indicated provide the following:

1. Restraint-Control Devices (MSS Type 47): To control pipe 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.

N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

P. Provide powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where indicated in concrete construction.

END OF SECTION 230529

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Warning tags.

1.3 SUBMITTALS

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

B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

C. Valve numbering scheme.

D. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 QUALITY ASSURANCE

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

1.5 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.

1. Data:
   a. Manufacturer, product name, model number, and serial number.
   b. Capacity, operating and power characteristics, and essential data.
   c. Labels of tested compliances.
2. Location: Accessible and visible.
3. Fasteners: As required to mount on equipment.

B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
1. Terminology: Match schedules as closely as possible.
2. Data:

   a. Name and plan number.
   b. Equipment service.
   c. Design capacity.
   d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

C. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch stainless steel, 0.025-inch aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Letter Color: White or black.
3. Background Color: Black or white.
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.

D. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch-thick, and having predrilled holes for attachment hardware.
2. Letter Color: White or black.
3. Background Color: Black or white.

4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

E. Access Panel and Door Markers: 1/16-inch-thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification.

1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

F. Label Content: Include equipment's drawing designation (tag) with unique equipment number as scheduled.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: White or black.

C. Background Color: Black or white.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include equipment's drawing designation (tag) with unique equipment number as scheduled. Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.

B. Pretensioned 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.

2.4 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch-thick, and having predrilled holes for attachment hardware.

B. Letter Color: White or black.

C. Background Color: Black or white.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

J. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Reinforced grommet and wire or string.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."

4. Color: Safety-yellow background with black lettering.

2.5 ACOUSTICAL CEILING GRID MARKER

A. General: Plastic tape a minimum of three one-thousandths of an inch thick (3.0 mils) with pressure-sensitive, permanent-type, self-adhesive back.

B. Width: three quarters of an inch (3/4") or 22 millimeters.

C. Letter Size: ¼" minimum or 8 millimeters.

D. Letter Color: Black

E. Tape Color: White.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 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.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 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 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 through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings, omit intermediately spaced labels.

B. Pipe Label Color Schedule:
1. Refrigerant Piping: Black letters on a safety-orange background.

3.5 DUCT LABEL INSTALLATION

A. Install duct markers with permanent adhesive on air ducts in colors complying with ASME A13.1.

B. Install plastic-laminated or self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue: For cold-air supply ducts.
2. Yellow: For hot-air supply ducts.
3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.

C. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.6 FIRE AND SMOKE DAMPERS

A. Access points for fire, smoke and fire-smoke dampers shall be permanently identified on the exterior of the duct by a label or sign with letters not less than 1" in height reading: "FIRE/SMOKE DAMPER, SMOKE DAMPER, or FIRE DAMPER."

3.7 ACOUSTICAL CEILING GRID MARKER INSTALLATION

A. Attach tape with indicated text to t-bar below item of equipment.

B. Attach tape to grid.

C. Prepare surface and attach tape in accordance with manufacturer' recommendations.

D. Surfaces to receive tape shall be clean and free of scale, dirt, and grease.

E. Center tape on support grid. Tape shall be visible from within space.

F. Provide with lettering at equipment located above lay-in tile ceilings including but not limited to:
   1. Valves: Text = V
   2. Air Handling Units: Text = AHU
   3. Air Removal Devices: Text = ARD
   4. Strainers: Text = S
   5. Terminal Units (VAV boxes): Text = TU
   6. Fan Coil Units: Text = FCU
   7. Blower Coils: Text = BC
   8. Coils: Text = C
   9. Heat Pumps: Text = HP
   10. Cabinet Unit Heaters: Text = CUH
   11. Fans: Text = F
   12. Damper operators: Text = D

3.8 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.9 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.10 CLEANING

A. Clean faces of mechanical identification devices [**and glass fronts of valve schedules**].

END OF SECTION 230553

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

A. Outdoor duct and pipe: Duct conveying untreated outside air at ambient temperature and humidity.

B. Outdoor pipe: Pipe located outside the building insulation envelope.

C. Supply air duct: Duct conveying air on the discharge side of an air handling unit or fan which will be delivered to a space in a building through a diffuser or connection to the return duct of another unit. Ductwork on the discharge side of a 100% outside air unit is considered to be Supply air duct.

D. Return air duct: Duct conveying air from a space or plenum that will return to an air handling unit or energy transfer device. The air may be returned to the supply air duct after being conditioned, or it may be exhausted after passing through an energy transfer device. Typical examples of an energy transfer devices are plate heat exchangers, runaround coils, heat pipes, and energy wheels.

E. Exhaust air duct: Duct conveying air from a space or plenum that will be exhausted from the building without being passed through an energy transfer device.

F. Plenum: An unoccupied space or void, on the conditioned side of the building insulation and vapor barrier, being used to return conditioned air to the inlet side of a return or exhaust fan either directly or via a duct connection. An example would be a space with air handling light fixtures or openings in the ceiling used to transport air through the ceiling and then to an open duct located above the ceiling in another location.

G. Indirectly Conditioned Space: A space having no direct conditioning but, due to air movement induced by an exhaust, or return opening, is conditioned by makeup air from an adjacent space. An example would be a small toilet. Boiler rooms, fan rooms, and mechanical rooms do not qualify as indirectly conditioned spaces.

H. Inside the Building Insulation Envelope: For the purposes of this section, boiler rooms, fan rooms, and mechanical rooms are considered to be OUTSIDE the building insulation envelope.

1.3 SUBMITTALS

A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

1. Product Data for Leed Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.

B. Shop Drawings: Show fabrication and installation details for the following:

1. Detail application of removable insulation covers.

2. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
3. Detail attachment and covering of heat tracing inside insulation.
4. Detail insulation application at pipe expansion joints for each type of insulation.
5. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
6. Detail removable insulation at piping specialties, equipment connections, and access panels.
7. Detail application of field-applied jackets.
8. Detail application at linkages of control devices.
9. Detail field application for each equipment type.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Ship insulation materials in containers marked by manufacturer with type, grade, and maximum use temperature.

B. Ship Insulated Piping System Components on pallets and wood supports. Securely fasten and protect from damage. Store off the ground and cover with opaque waterproof tarp to protect materials from sunlight and rain.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation, duct Installer for duct insulation, and equipment Installer for equipment insulation.

C. Maintain clearances required for maintenance.

D. Coordinate installation and testing of heat tracing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers:

1. Mineral-Fiber Insulation:
   a. CertainTeed Corporation.

b. Johns Manville.
c. Knauf Insulation.
d. Owens Corning.

2. Flexible Elastomeric Thermal Insulation:
   a. Aeroflex USA, Inc.
   b. Armacell, LLC.
   c. K-Flex USA.

3. Polyolefin Insulation:
   a. Armstrong World Industries, Inc.
   b. IMCOA.

4. Closed-Cell Phenolic-Foam Insulation:
   a. Kooltherm Insulation Products, Ltd.

5. Calcium Silicate Insulation:
   a. Johns Manville.
   b. Owens Corning.

6. Removable Insulation Covers:
   a. Advance Thermal Corp.

B. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

C. Products shall not contain asbestos, lead, mercury, or mercury compounds.

D. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

G. Duct Liner: Refer to specification section "Metal Ducts"

H. Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, with factory applied FSK Jacket. Meet the requirements of ASTM C 1290, Type III, inorganic glass fibers bonded by a thermosetting resin to maximum service temperature of 250°F.. Faced insulation shall not exceed 25 Flame Spread, 50 Smoke Developed when tested in accordance with ASTM E84.

I. Semi-Rigid Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 1136, Type I, II, III, & IV with factory applied all-service jacket (ASJ) or Type II, IV with factory applied Foil Scrim Kraft (FSK) jacket.

J. Mineral-Fiber Blanket with Factory Applied FSK Jacket: Meet the requirements of ASTM C 1290, Type III, inorganic glass fibers bonded by a thermosetting resin with a multi-purpose foil-scrim kraft (FSK) jacket to maximum service temperature of 250°F. FSK shall meet the requirements of ASTM C 1136, Type II, when surface burning characteristics are determined in accordance with ASTM E 84 with the foil surface of the material exposed to the flame as it is in

the final composite. Composite (insulation, facing and adhesive) shall not exceed 25 Flame Spread, 50 Smoke Developed when tested in accordance with ASTM E 84. Insulation properties shall be as follows:

1. Thickness: 1-1/2"
   a. Density: 0.75 pcf
   b. Minimum uncompressed R value: 5.1
   c. Minimum installed R value assuming 25% compression: 4.2

2. Thickness: 2"
   a. Density: 1.0 pcf
   b. Minimum uncompressed R value: 7.4
   c. Minimum installed R value assuming 25% compression: 6.0

3. Alternate to 2" 1.0 pcf: Thickness: 2.2"
   a. Density: 0.75 pcf
   b. Minimum uncompressed R value: 7.4
   c. Minimum installed R value assuming 25% compression: 6.0

4. Thickness: 3"
   a. Density: 0.75 pcf
   b. Minimum uncompressed R value: 10.2
   c. Minimum installed R value assuming 25% compression: 8.3

K. Mineral-Fiber Pipe Insulation: Glass fibers bonded with a thermosetting resin complying with the following:

1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
2. Semi-Rigid Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 1136, Type I, II, III, IV with factory applied all-service jacket (ASJ) or Type II, IV with factory applied Foil Scrim Kraft (FSK) jacket.
3. Blanket Insulation: Comply with ASTM C 553, Type II, without facing.
4. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:
   a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
   b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
5. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.

L. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Adhesive: As recommended by insulation material manufacturer.
2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.

M. Closed-Cell Phenolic-Foam: Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.

N. Cellular-Glass: Inorganic, foamed or cellulated glass, annealed, rigid, hermetically sealed cells, incombustible preformed pipe Insulation, with jacket. Comply with ASTM C 552, Type II, Class 2.

O. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

2.2 FIELD-APPLIED JACKETS

A. General: ASTM C 921, Type 1, unless otherwise indicated.

B. Glass Cloth: Woven glass-fiber fabric, plain weave, minimum 8 ounces per square yard.

C. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.

D. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.

1. Adhesive: As recommended by insulation material manufacturer.
2. PVC Duct Jacket Color: White or gray.
3. PVC Pipe Jacket Color: Color-code piping jackets based on materials contained within the piping system.

E. Aluminum Jacket: Smooth or stucco embossed sheets manufactured from aluminum alloy complying with ASTM B 209 and having an integrally bonded moisture barrier over entire surface in contact with insulation. Factory cut and rolled to indicated sizes. Comply with ASTM B 209, 3003 alloy, H-14 temper.

1. Finish and Thickness: Stucco-embossed finish, 0.016 inch thick.
2. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.
3. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.

F. Stainless-Steel Jacket: Smooth or stucco embossed sheets of stainless steel complying with ASTM A 666, Type 304 or 316; 0.10 inch thick; and roll stock ready for shop or field cutting and forming to indicated sizes.

1. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.
2. Elbows: Gore type, for 45- and 90-degree elbows in same material, finish, and thickness as jacket.
3. Jacket Bands: Stainless steel, Type 304, 3/4 inch wide.

G. Heavy PVC Pipe Fitting Covers: Factory-fabricated fitting covers manufactured from 30-mil-thick, high-impact, ultraviolet-resistant PVC.

1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
2. Adhesive: As recommended by insulation material manufacturer.

H. Standard PVC Pipe Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil- thick, high-impact, ultraviolet-resistant PVC.

1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.

2. Adhesive: As recommended by insulation material manufacturer.

2.3 REMOVABLE INSULATION COVERS

A. Pre-manufactured easily removable insulation cover/blanket intended for insulation of equipment and devices requiring periodic maintenance.

B. For chilled water pumps, provide min 22-gauge stainless steel box around suction diffuser and pump housing with 2" thick close cell elastomeric insulation liner adhered to inside of box. The box shall be designed to be in two (2) halves with latching clips/ latches for easy removal and re-installation. Where the two halves come together, there should be gasketing material for tight seal and along base. Alternative acceptable approaches are the use of pump insulation covers manufactured by Fit Tight Covers design for removable pump insulation covers.

2.4 ACCESSORIES AND ATTACHMENTS

A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd..

1. Tape Width: 4 inches.

B. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:

1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.
2. Galvanized Steel: 0.005 inch thick.
3. Aluminum: 0.007 inch thick.
4. Brass: 0.010 inch thick.
5. Nickel-Copper Alloy: 0.005 inch thick.

C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.

D. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.

1. Welded Pin Holding Capacity: 100 lb for direct pull perpendicular to the attached surface.

E. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct, pipe, plenum and breeching with adhesive. Pin length sufficient for insulation thickness indicated.

1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, pipes, plenums, and breechings; and to achieve a holding capacity of 100 lb. for direct pull perpendicular to the adhered surface.

F. Self-Adhesive Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct, pipe, and plenum with adhesive. Pin length sufficient for insulation thickness indicated.

G. Pipe Attachments for Flexible Elastomeric Insulation: Provide pipe support with high compressive strength material insert imbedded in closed-cell elastomeric foam to prevent condensation and insulation damage at support points. Provide friction insulation tape for connection of pipe insulation to pipe support system.

1. Manufacturers:
   a. Aeroflex – Aerofix

b. Armacell – Armafix Ecolight
c. Cooper B-Line, Inc. / Eaton – Armafix
d. K-Flex USA – K-Flex 360 Pipe Support
e. ZSi-Foster – Cush-A-Therm

2.5 VAPOR RETARDERS

A. Mastics: Materials that are compatible with insulation materials, jackets, and substrates.

2.6 REMOVABLE INSULATION COVERS

A. Pre-manufactured easily removable insulation cover/blanket intended for insulation of equipment and devices requiring periodic maintenance.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

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

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of ducts, piping, and fittings.

B. Refer to schedules at the end of this Section for materials, forms, jackets, and thickness required for each system.

C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Apply 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. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

G. Keep insulation materials dry at all times. Insulation that becomes wet or is otherwise damaged beyond repair, shall be removed immediately and replaced. Replacement material and installation shall be in accordance with these specifications.

H. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

I. Apply insulation with the minimum number of joints practical.

J. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

K. Refer to special instructions for applying insulation over fittings, valves, and specialties.

L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.

1. Apply insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

M. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

N. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.
2. Joints and Seams: Cover with tape and vapor retarder to maintain vapor seal.
3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to duct flanges, pipe joints, and fittings.

O. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.

P. Install vapor-retarder mastic on ducts, pipes, plenums, and equipment.

1. Ducts, pipes, plenums, and equipment with Vapor Retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape and mastic to maintain vapor-retarder seal.
2. Ducts, pipes, plenums, and equipment without Vapor Retarders: Overlap insulation facing at seams and secure with outward clinching staples and pressure-sensitive tape having same facing as insulation.

Q. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.

1. Seal penetrations with vapor-retarder mastic.
2. Apply insulation for exterior applications tightly joined to interior insulation ends.
3. Seal insulation to roof flashing with vapor-retarder mastic.

R. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.

S. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.

T. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.

1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.

3.4 MINERAL-FIBER INSULATION APPLICATION

A. Blanket Applications for Ducts, Pipes, and Plenums: Secure blanket insulation with adhesive, and anchor pins with speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct, pipe, and plenum surfaces.
2. Apply adhesive to entire circumference of ducts & pipes and to all surfaces of fittings and transitions. Adhesive may be omitted from the top of horizontal rectangular ducts.
3. Install anchor pins and speed washers on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
   a. On duct sides with dimensions 18 inches and smaller, 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 16 inches o.c. each way, and 3 inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
   c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not compress insulation to less than 75% of its original thickness during installation.
4. Install anchor pins and speed washers on sides, top, and bottom of horizontal pipes.
5. Impale insulation over anchors and attach speed washers.
6. Cut excess portion of pins extending beyond speed washers. Cover exposed pins and washers with tape matching insulation facing.
7. 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 segment with 1/2-inch staples, 1-inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
8. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches o.c.
9. Apply insulation on rectangular duct elbows, pipe fittings, and transitions with a full insulation segment for each surface. Apply insulation on round and flat-oval duct elbows, and pipe elbows, with individually mitered gores cut to fit the elbow.
10. Insulate duct and pipe stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch- wide strips of the same material as insulation. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
11. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

B. Board Applications for Ducts, Plenums, & Equipment: Secure board insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct, plenum, & equipment surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings, transitions, and equipment. Adhesive may be omitted from top surface of horizontal rectangular ducts.
3. Space anchor pins as follows:
   a. On duct & equipment sides with dimensions 18 inches and smaller, along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct & equipment sides with dimensions larger than 18 inches. Space 16 inches o.c. each way, and 3 inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at bracing.
   c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not compress insulation to less than 75% of its original thickness during installation.
4. Cut excess portion of pins extending beyond speed washers. Cover exposed pins and washers with tape matching insulation facing.
5. 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 segment with 1/2-inch staples, 1-inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
6. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct and equipment stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6" wide strips of the insulating materia. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
8. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

3.5 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Apply insulation to ducts, plenums, and equipment as follows:

1. Follow the manufacturer's written instructions for applying insulation.
2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the duct, plenum, and equipment surface.

3.6 CLOSED-CELL PHENOLIC-FOAM INSULATION APPLICATION

A. Apply insulation as follows:

1. Secure each layer of insulation with stainless-steel bands at 12-inch intervals and tighten without deforming the insulation materials.
2. Apply two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch, soft-annealed, stainless steel wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. On exposed applications, finish insulation with a skim coat of mineral-fiber, hydraulic-setting cement to surface of installed insulation. When dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch.

Apply finish coat of lagging adhesive over glass cloth or tape. Thin the finish coat to achieve smooth finish.

3.7 FIELD-APPLIED JACKET APPLICATION

A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.

1. Apply jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of jacket manufacturer's recommended adhesive.
3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

3.8 FINISHES

A. Glass-Cloth Jacketed Insulation: Paint insulation finished with glass-cloth jacket as specified in Division 9 Section "Paints."

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color shall be as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

3.9 DIFFUSER APPLICATIONS

A. Insulate exposed metal surfaces on top of all supply diffusers. Where diffusers are mounted in a metal pan, insulate the top of the pan.

1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
2. Thickness: 1 inch.
3. Vapor Retarder Required: Yes.

B. Insulate slot diffuser plenums where uninsulated plenums are provided.

3.10 APPLICATIONS

A. Insulation materials and thickness are specified at the end of this Section.

B. Insulate all ductwork, pipe and equipment:

1. Insulate ductwork in accordance with the application schedule(s) below.
2. Exceptions: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
    a. Vibration-control devices.
    b. Testing agency labels and stamps.
    c. Nameplates and data plates.
    d. Handholes.
    e. Cleanouts.
    f. Plastic condensate drain piping.
    g. Pipe-mounted condensate sensors.
    h. Return ductwork inside the building insulation envelope.
    i. Indoor exposed return air ductwork.
    j. Exhaust ductwork.

1) Exception: Duct beginning 18" upstream of backdraft damper and continuing to building envelope insulation.

k. Metal ducts with duct liner.
l. Factory-insulated flexible ducts.
m. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.
n. Flexible connectors.
o. Access panels and doors in air-distribution systems.
p. Ductwork used for smoke control supply and exhaust.

3.11 INDOOR APPLICATION SCHEDULE

A. Service: Condensate drain piping except plastic.

1. Insulation Material: Mineral fiber preformed pipe insulation.
2. Insulation Thickness: 1"
3. Vapor Retarder Required: Yes.
4. Finish: Finished Spaces = Painted, concealed = none.

B. Refrigerant Suction and Hot-Gas Piping/Tubing:

1. Insulation Material and Thickness:
   a. Cellular Glass: 1-1/2 inches thick.
   b. Flexible Elastomeric: 1 inch thick.
   c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

C. Service: Unless otherwise indicated provide the following:

1. Concealed Ducts and Plenums:
   a. Material: Mineral-Fiber Blanket.
   b. Thickness: 2 inches.
   c. Vapor Retarder Required: Yes.

2. Ducts and Plenums in Finished Spaces:
   a. Material: Mineral-Fiber Board.
   b. Thickness: 1-1/2 inches.
   c. Field-Applied Jacket: Glass cloth.
   d. Vapor Retarder Required: Yes.
   e. Paint: Color as selected by architect. Refer to section "Painting".

D. Service: Round and flat oval, supply-air ducts, concealed and within the building insulation envelope.

1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
2. Thickness: 1-1/2 inches.
3. Vapor Retarder Required: Yes.

E. Service: Round and flat oval, outside-air ducts, concealed and within the building insulation envelope.

1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
2. Thickness: 1-1/2 inches.
3. Vapor Retarder Required: Yes.

F. Service: Rectangular, supply-air ducts, concealed and within the building insulation envelope.

1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
2. Thickness: 1-1/2 inches.
3. Vapor Retarder Required: Yes.

G. Service: Rectangular, outside-air ducts, concealed and within the building insulation envelope.

1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
2. Thickness: 1-1/2 inches.
3. Vapor Retarder Required: Yes.

H. Service: Round and flat oval, supply-air ducts, concealed in vented attics and in unvented attics with insulated ceilings.

1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
2. Thickness: 2 inches.
3. Vapor Retarder Required: Yes.

I. Service: Round and flat oval, return-air ducts, concealed in vented attics and unvented attics with insulated ceilings.

1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
2. Thickness: 1-1/2 inches.
3. Vapor Retarder Required: Yes.

J. Service: Rectangular, supply-air ducts, concealed in vented attics and unvented attics with insulated ceilings.

1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
2. Thickness: 2 inches.
3. Vapor Retarder Required: Yes.

K. Service: Rectangular, return-air ducts, concealed in vented attics and unvented attics with insulated ceilings.

1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
2. Thickness: 1-1/2 inches.
3. Vapor Retarder Required: Yes.

L. Service: Round and flat oval, supply-air ducts, exposed.

1. Refer to section "Metal Ducts"

M. Service: Round and flat oval, outside-air ducts, exposed.

1. Refer to section "Metal Ducts"

N. Service: Rectangular, supply-air ducts, in Finished Spaces.

1. Material: Mineral-Fiber Board Thermal Insulation, Unfaced
2. Thickness: 1-1/2 inches.
3. Field-Applied Jacket: Glass cloth.
4. Vapor Retarder Required: Yes.
5. Paint: Color as selected by architect. Refer to section "Painting".

O. Service: Rectangular, outside-air ducts, in Finished Spaces.

1. Material: Mineral-Fiber Board Thermal Insulation, Unfaced
2. Thickness: 2 inches
3. Field-Applied Jacket: Glass cloth.

4. Vapor Retarder Required: Yes.
5. Paint: Color as selected by architect. Refer to section "Painting".

P. Service: Range-hood exhaust ducts, concealed and in Finished Spaces.

1. Range hood exhaust ducts shall be listed, labeled, factory-built, and insulated commercial kitchen grease ducts as specified in section "Metal Ducts".

3.12 OUTDOOR APPLICATION SCHEDULE

A. Insulation shall be applied after heat tracing and temperature sensors are in place and have been tested.

B. Service: Chilled water supply and return.

1. Insulation Material: Flexible elastomeric.
2. Insulation Thickness: 1 1/2".
3. Field-Applied Jacket: Aluminum.
4. Vapor Retarder Required: Yes.
5. Finish: Two coats UV protectant applied to flexible elastomeric insulation prior to installation of aluminum jacket.

C. Refrigerant Suction and Hot-Gas Piping:

1. Insulation Material and Thickness:
   a. Cellular Glass: 2 inches thick.
   b. Flexible Elastomeric: 2 inches thick.
   c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
2. Finish: Two coats of UV coating or mastic protectant recommended by the insulation manufacturer or outdoor aluminum jacket.

D. Service: Round, supply-air ducts.

1. Material: Round supply air ducts shall be factory fabricated double wall ducts as specified in section "Metal Ducts".

E. Service: Round, return-air ducts.

1. Material: Round supply air ducts shall be factory fabricated double wall ducts as specified in section "Metal Ducts".

F. Service: Rectangular, supply-air ducts.

1. Material: Mineral-fiber board.
2. Total Thickness: 2 Inches (two 1" layers).
3. Number of Layers: Two
4. Field-Applied Jacket: Glass cloth.
5. Vapor Retarder Required: Yes
6. Outer Jacket: Smooth or stucco embossed aluminum.
   a. Thickness: Minimum 0.024 inches.

G. Service: Rectangular, return-air ducts.

1. Material: Mineral-fiber board.
2. Total Thickness: 2 Inches (two 1" layers).
3. Number of Layers: Two
4. Field-Applied Jacket: Glass cloth.

5. Vapor Retarder Required: Yes
6. Outer Jacket: Smooth or stucco embossed aluminum.
    a. Thickness: Minimum 0.024 inches.

END OF SECTION 230700

SECTION 230900 – BUILDING AUTOMATION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

B. Related Sections include the following:

1. Division 23 Section "Meters and Gages for HVAC Piping" for measuring equipment that relates to this Section.
2. Division 23 Section "Sequences of Control" for requirements that relate to this Section.
3. Division 28 Sections for additional conduit requirements for all electronic safety and security systems specified under Division 28.

C. Work Under Other Sections:
1. All wells, valves, taps, dampers, flow stations, etc. furnished by the BAS manufacturer shall be installed under Section "Hydronic Piping."
2. The following shall be provided under Division 23 specifications sections:
    a. 120V power to BAS panels and devices with circuits indicated on the drawings. Refer to "Coordination" paragraph below.
    b. Wiring of power feeds to disconnect switches and starters.
    c. Wiring from disconnect switches and starters to electric motors.
    d. Wiring of any remote start/stop switches and manual or automatic motor speed control devices not furnished under this section of the specifications.

D. Existing Siemens BAS system is in place. The purpose of this specification is to provide requirements for additional control accessories to connect the new equipment to the existing BAS system.

E. Update all graphics for new equipment.

1.3 DEFINITIONS

A. AI: Analog Input (analog value input to the BAS from the unit controller)

B. AO: Analog Output (analog value output from BAS to the unit controller)

C. BAS: Building Automation System.

D. BI: Binary Input (binary value input to the BAS from the unit controller)

E. BO: Binary Output (binary value output from BAS to the unit controller)

F. CxA: Commissioning Authority or Agent.

G. DDC: Direct digital control.

H. I/O: Input/output.

I. IT: Information Technology.

J. IS: Information Systems.

K. LAN: Local Area Network.

L. MS/TP: Master-slave/token-passing

M. NAC: Network area controllers.

N. PC: Personal computer.

O. PID: Proportional plus integral plus derivative.

P. PPM: Parts per million.

Q. RTD: Resistance temperature detector.

R. TAB: Testing, Adjusting and Balancing.

S. WAN: Wide-Area Network

1.4 SYSTEM DESCRIPTION

A. Control system consists of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.

B. Control system includes interface to the following:
   1. Division 28 sections on Electronic Safety and Security Systems. Provide interface outputs for selective annunciation and monitoring (i.e. alarm status).
   2. Building lighting control system specified in Division 26 Section "Lighting Control Devices."
   3. Fire alarm system specified in Division 28 Section "Digital Addressable Fire Alarm."

1.5 WARRANTY

A. Provide all services, materials and equipment necessary for the successful operation of the entire BAS system for a period of one year beginning on the date of Substantial Completion.

B. Services, materials, and equipment shall include but not be limited to:
   1. The adjustment, required testing, and repair of the system including all computer equipment, transmission lines, transmission equipment, sensors and control devices.
   2. On-line support services shall be provided as follows:
      a. The local BAS representative shall have the capability to monitor and control the facility's building automation system via an internet connection.
      b. If the problem is not resolved by local support, the national office of the building automation system manufacturer, having the same dialup capability, shall also provide online support.

1.6 SUBMITTALS

A. Pre-submittal meeting: The Contractor performing work under this Section of the specifications shall attend a meeting for coordinating the control system with major pieces of equipment including rooftop units; HVAC packaged pumping system, chillers and boilers. The meeting shall be held on the project site in the contractor's trailer or other location acceptable to the Contractor. The Contractor shall be responsible for arranging the meeting. Submittals shall be essentially complete at the time of the meeting so detailed coordination items can be discussed.

B. Submit ten (10) complete sets of documentation in the following phased delivery schedule:
   1. Schedule of dampers including size, leakage, and flow characteristics.
   2. Schedule of valves including leakage and flow characteristics.
   3. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated. Include each control device labeled with setting or adjustable range of control.
   4. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection. Include the following:
      a. System schematics, including:
         1) Written sequences of operation
         2) Listing of connected data points, including connected control unit and input device.
            a) point names
            b) point addresses
         3) Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
         4) Details of control panel faces, including controls, instruments, and labeling.
         5) Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
         6) Trunk cable schematic showing programmable control unit locations and trunk data conductors.
         7) System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
         8) System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.

C. Maintenance Data: For systems to include in maintenance manuals specified in Division 1. Include the following:
   1. Maintenance instructions and lists of spare parts for each type of control device.
   2. Interconnection wiring diagrams with identified and numbered system components and devices.
   3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
   4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
   5. Calibration records and list of set points.

D. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise Shop Drawings to reflect actual installation and operating sequences.

E. Upon project completion, submit operation and maintenance manuals, consisting of the following:
   1. Index sheet listing contents in alphabetical order.
   2. Manufacturer's equipment parts list of all functional components of the system.
   3. CD-ROM of system schematics including wiring diagrams.
   4. Sequence of operations
   5. As-built interconnection wiring diagrams.
   6. Operator's manual.
   7. Trunk cable schematic showing remote electronic panel locations and all trunk data.
   8. List of connected data points, including panels to which they are connected and input device (sensors, thermostat, etc.)
   9. Software and firmware operational documentation. Include the following:
      a. Software operating and upgrade manuals.
      b. Program software backup: On a magnetic media or compact disc, complete with data files.
      c. Device address list.
      d. Printout of software application and graphic screens.
      e. Software license required by and installed for DDC workstations and control systems.
   10. Software Upgrade Kit: For Owner to use in modifying software to suit future power system revisions or monitoring and control revisions.
   11. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

F. Submit product data sheets for airflow measuring devices indicating minimum placement requirements, sensor density, sensor distribution, and installed accuracy to the host control system. Submit a schedule of airflow measuring devices indicating compliance with specified accuracy at minimum and maximum airflow rates. Submit installation, operation and maintenance documentation.

1.7 QUALITY ASSURANCE

A. The BAS system shall be designed and installed, commissioned, and serviced by a manufacturer's authorized installer.

B. Manufacturer Qualifications: A firm experienced in manufacturing automatic temperature-control systems similar to those indicated for this Project and with a record of successful in-service performance.

C. All materials and equipment used shall be standard components, regularly manufactured for this and/or other systems and not custom designed special for this project.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Section 15, governing radio frequency electromagnetic interference and shall be so labeled.

F. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."

1.8 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory-mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

B. System Software: Update to latest version of software at Project completion.

1.9 COORDINATION

A. Control Wiring: The BAS manufacturer shall be responsible for all BAS and temperature control wiring for a complete and operable system. All wire and cable shall be plenum-rated and shall be in accordance with Division 26 specification sections and all local, state and national codes and ordinances.

B. Where plenum-rated BAS cable is routed in concealed, accessible spaces, the cable may be run in the cable trays or in J-Hooks provided under this section of the specifications. Where plenum-rated BAS cable is routed in exposed or inaccessible areas, it shall be run conduit provided under this section of the specifications.

C. Power Wiring:
   1. Power wiring indicated (device and circuit designation indicated) on the drawings shall be provided under Division 26.
   2. The BAS manufacturer shall be responsible for power wiring not indicated (device or circuit designation not indicated) on the Drawings. It shall be the BAS manufacturer's responsibility to review the Contract Documents to determine the extent of power wiring included in Division 26 and to provide additional power wiring as required. Work shall be in accordance with Division 26 specifications and all local, state and national codes and ordinances.
   3. Where the contractor performing work under this section requires an additional circuit for power wiring to a device or panel under paragraph 2 above, an RFI shall be issued requesting approval to use an available circuit in the nearest panel. Once approval is

granted, all wiring and conduit from the breaker to the device or panel shall be provided under this section of the specifications.

D. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. All conduits shall be concealed within walls and above ceilings unless indicated otherwise.

E. Coordinate installation of conduit to avoid cutting of finished surfaces.

F. Coordinate equipment with Division 28 Section "Common Work Results for Electronic Safety and Security" for building security control detection system and selective annunciation and monitoring only (i.e. 'status alarms').

G. Coordinate equipment with Division 27 Section "GPS Wireless Clock System" to achieve compatibility with equipment that interfaces with that system.

H. Coordinate equipment with Division 26 Section "Lighting Control Devices" to achieve compatibility with equipment that interfaces with that system.

I. Coordinate equipment with Division 28 Section "Digital Addressable Fire Alarm" to achieve compatibility with equipment that interfaces with that system.

J. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.

K. Coordinate equipment with Division 26 Section "Panelboards" to achieve compatibility with starter coils and annunciation devices.

L. Coordinate equipment with Division 26 Section "Switchboards" to achieve compatibility with power monitoring and metering devices in that equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:
1. Siemens (Existing BAS with Desigo Front End))

B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

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2.2 DDC EQUIPMENT

A. Existing Operator Workstations: All BAS interface software should be installed on the existing head end computers, coordinate desired computers with owner. Provide at least two hard copies on CD or DVD of all software required for interface. Provide 2 copies of software tools required to modify programming and sequences of operation.
   1. Application Software:
      a. I/O capability from operator station.
      b. System security for each operator via software password and access levels.
      c. Automatic system diagnostics; monitor system and report failures.
      d. Database creation and support.
      e. Automatic and manual database save and restore.
      f. Dynamic color graphic displays with up to 10 screen displays at once.
      g. Custom graphics generation and graphics library of HVAC equipment and symbols.
      h. Alarm processing, messages, and reactions.
      i. Trend logs retrievable in spreadsheets and database programs.
      j. Alarm and event processing.
      k. Object and property status and control.
      l. Automatic restart of field equipment on restoration of power.
      m. Data collection, reports, and logs. Include standard reports for the following:
         1) Current values of all objects.
         2) Current alarm summary.
         3) Disabled objects.
         4) Alarm lockout objects.
         5) Logs.
      n. Custom report development.
      o. Workstation application editors for controllers and schedules.
      p. Maintenance management.

B. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.

   1. Binary Inputs: Allow monitoring of on-off signals without external power.
   2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
   3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
   4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights.
   5. Analog Outputs: Provide either modulating signal, low voltage (0- to 10-V dc) or current (4 to 20 mA) with status lights, two-position (auto-manual) switch, and manually adjustable potentiometer.

6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
7. Universal I/Os: Provide software selectable binary or analog outputs.

C. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:

1. Output ripple of 5.0 mV maximum peak to peak.
2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

2.3 DDC CONTROLLERS

A. No controller shall be loaded to more than 80%. IE: A controller with 20 available points shall be loaded with 16 points or less.

B. DDC controllers shall be stand-alone, multi-tasking, multi-user, real-time digital control processors consisting of modular hardware with plug-in enclosed processors, communication controllers, power supplies and input/output point modules. Controller size shall be sufficient to fully meet the requirements of the contract documents. Each controller shall support a minimum of two (2) LAN Device Networks.

C. Each DDC controller shall have sufficient memory to support its own operating system and databases, including:
1. Control processes
2. Energy management applications
3. Alarm management applications including custom alarm messages for each level alarm for each point in the system.
4. Historical/trend data for points specified.
5. Maintenance support applications.
6. Custom processes.
7. Operator I/O.
8. Dial-up communications.
9. Manual override monitoring.

D. Each DDC controller shall support any combination of industry standard inputs and outputs.

E. Provide all processors, power supplies and communication controllers so that the implementation of a point only requires the addition of the appropriate point input/output termination module and wiring.

F. DDC controllers shall provide a minimum two RS-232C serial data communication ports for operation of operator I/O devices such as industry standard printers, operator terminals, modems and portable laptop operator's terminals. DDC controllers shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems, Ethernet connections, printers, or terminals.

G. Each DDC controller shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all panel components. The DDC controller shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication.

H. Isolation shall be provided at all peer-to-peer network terminations, as well as all field point terminations to suppress induced voltage transients consistent with IEEE Standards 587-1980.

I. In the event of the loss of normal power, there shall be an orderly shutdown of all DDC controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 100 days.
   1. Upon restoration of normal power, the DDC controller shall automatically resume full operation without manual intervention.
   2. Should DDC controller memory be lost for any reason, the system shall automatically reload the DDC controller via the local RS-232C port, via telephone line dial-in or Ethernet from the existing network workstation PC.

J. Provide a separate DDC controller for each RTU or other HVAC system. It is intended that each unique system be provided with its own point resident DDC controller.

2.4 BACNET/LON DOAS UNIT CONTROL PANEL CONNECTION

A. Unit mounted control for rooftop unit shall have BACnet or LON communications card to communicate with BAS. Provide minimum points as required to accomplish unit operation as described in "Sequences of Operation". At a minimum provide below points through BACnet or LON interface.
   1. AI Supply Air Temperature
   2. AI Supply Air Duct Static Pressure
   3. AI Space Static Pressure
   4. AI Mixed Air Temperature
   5. AI Return Air Temperature
   6. AI Ventilation Air Flow
   7. AI Return Air Humidity
   8. AI Return Air Flow Rates
   9. AI Supply Fan Variable Frequency Drive (VFD) Command Value
   10. AI Relief Fan VFD Command Value
   11. AI Relief Air Damper Command Value
   12. AI Mixed Air Dampers Command Value
   13. AI Economizer Outside Air Damper Command Value
   14. AI Hot Water Valve Command Value
   15. BI Supply Fan Status
   16. BI Relief Fan Status
   17. BI Exhaust Fan Status
   18. BI Entering DX Coil Dirty Filter
   19. BI Each Stage of Cooling
   20. AO Supply Air Temperature Setpoint
   21. AO Supply Air Duct Static Pressure Setpoint

22. AO Outside Air Minimum Flow Setpoint (To be used to shut outside air damper during night cycle, warm-up and cool-down modes)
23. BO Occupied Mode
24. BO Unoccupied Mode
25. BO Cooling Lockout Mode

2.5 APPLICATION SPECIFIC CONTROLLERS (ASC)

A. Each DDC Controller shall be able to extend its performance and capacity using remote application specific controllers (ASCs) through LAN Device Networks.

B. Each ASC shall operate as a stand-alone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a microprocessor-based, multi-tasking, real-time digital control processor. Provide the following types of ASCs as a minimum:
   1. Terminal Equipment Controllers
      a. Terminal Box (VAV box controllers) should have a differential pressure transmitter (transducer) accuracy of 0.015-inches w.g. or less.

C. Each ASC shall be capable of control of the terminal device independent of the manufacturer of the terminal device.

D. Terminal Equipment Controllers:
   1. Provide for control of each piece of equipment , including, but not limited to, the following:
      a. Terminal Units
      b. Exhaust fans
      c. Fan Coil Units

2.6 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

B. Thermistor Temperature Sensors and Transmitters and Resistance Temperature Detectors and Transmitters:
   1. Accuracy: Plus or minus 0.5 deg F at calibration point.
   2. Wire: Twisted, shielded-pair cable.
   3. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
   4. Averaging Elements in Ducts: 36 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft.
   5. Insertion Elements for Liquids: Brass or stainless steel socket with minimum insertion length of 2-1/2 inches.
   6. Room Sensor Cover Construction: Manufacturer's standard locking covers.
      a. Set-Point Adjustment (training rooms, control rooms, offices, work rooms and conference rooms): Exposed warmer/cooler slider. Range of adjustment capable at zone sensor shall be programmable through the BAS.

b. Set-Point Adjustment (other spaces): Concealed.
c. Set-Point Indication: Concealed.
d. Thermometer: (Data/Security room only): LCD display of room temperature for monitoring purposes only.
e. Thermometer (all other spaces): Concealed.
f. Color: Manufacturer's standard.
g. Orientation: Vertical.

7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
8. Specific Sensor Type Locations: In corridors, lobbies, stairs, restrooms/toilets, locker rooms, booking, sally ports (RTU-2 space temperature sensors), secure areas & common area locations, provide blank stainless-steel cover plate sensors with insulated back and security screws.

C. Humidity Sensors: Capacitance or bulk polymer resistance type.
1. Accuracy: 5 percent full range with linear output.
2. Room Sensor Range: 20 to 80 percent relative humidity.
3. Room Sensor Cover Construction: Manufacturer's standard locking covers.
a. Color: Manufacturer's standard.
b. Orientation: Vertical.
4. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of 0 to 185 deg F.
5. Duct-Mounted: Electric insertion, 2-position type with adjustable, 2 percent throttling range, 20 to 80 percent operating range, and single- or double-pole contacts.

D. Pressure Transmitters/Transducers:
1. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input and temperature-compensated.
a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
b. Output: 4 to 20 mA.
c. Building Static-Pressure Range: 0- to 0.25-inch wg.
d. Duct Static-Pressure Range: 0- to 5-inch wg.
2. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.
3. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.
4. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential. Accuracy shall be +/- 5% of range.
5. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.

E. Current Sensing Switch:
1. Sensor supply voltage and supply current shall be induced from monitored conductor. Contact rating shall be 0.2 amperes at 30 volts DC/AC. Trip set point shall be adjustable to +/-1% of range. Current sensing switch wiring shall not be polarity sensitive.

F. Liquid Level Sensors:
1. Liquid level sensors shall have ½" accuracy calibrated to detect water in temperature range from 60°F to 80°F. Output signal shall be 4 to 20 mA. Sensor material shall be stainless steel or other non-corrosive material.

2.7 STATUS SENSORS

A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.

B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig, piped across pump.

C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.

D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.

E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.

F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

H. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.

2.8 TEMPERATURE AND HUMIDITY MONITORING SCREENS

A. Touch screen user interface with LCD display of temperature and humidity in animal testing and holding room. Readouts in °F and % RH. Shall be able to change set points from this user interface.

2.9 THERMOSTATS

A. Available Manufacturers:
1. Danfoss Inc.; Air-Conditioning and Refrigeration Div.
2. Heat-Timer Corporation.
3. Tekmar Control Systems, Inc.

B. Combination Thermostat and Fan Switches: Line-voltage thermostat with push-button or lever-operated fan switch.

1. Label switches "FAN ON-OFF" or "FAN HIGH-LOW-OFF" or "FAN HIGH-MED-LOW-OFF."
2. Mount on single electric switch box.

C. Electric, solid-state, microcomputer-based room thermostat with remote sensor.
   1. Automatic switching from heating to cooling.
   2. Preferential rate control to minimize overshoot and deviation from set point.
   3. Set up for four separate temperatures per day.
   4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
   5. Short-cycle protection.
   6. Programming based on every day of week.
   7. Selection features include degree F or degree C display, 12- or 24-hour clock, keyboard disable, remote sensor, and fan on-auto.
   8. Battery replacement without program loss.
   9. Thermostat display features include the following:
      a. Time of day.
      b. Actual room temperature.
      c. Programmed temperature.
      d. Programmed time.
      e. Duration of timed override.
      f. Day of week.
      g. System mode indications include "heating," "off," "fan auto," and "fan on."

D. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.

E. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.

   1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.
   2. Selector Switch: Integral, manual on-off-auto.

F. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.

   1. Bulbs in water lines with separate wells of same material as bulb.
   2. Bulbs in air ducts with flanges and shields.
   3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.
   4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
   5. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.
   6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.

G. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.

H. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.

I. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic- reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.

1. Bulb Length: Minimum 20 feet.
2. Quantity: One thermostat for every 20 sq. ft. of coil surface.

J. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic- reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above set point.

1. Bulb Length: Minimum 20 feet.
2. Quantity: One thermostat for every 20 sq. ft. of coil surface.

K. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, with molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psig, and cast housing with position indicator and adjusting knob.

2.10 ACTUATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.

1. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
4. Spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.

B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

1. Valves: Size for torque required for valve close off at maximum pump differential pressure.
2. Dampers: Size for running torque calculated as follows:

a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft of damper.
d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.

3. Coupling: V-bolt and V-shaped, toothed cradle.
4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
6. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
7. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
8. Temperature Rating: Minus 22 to plus 122 deg F.
9. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F.

2.11 DAMPERS

A. Dampers: AMCA-rated, parallel or opposed-blade design; 0.108-inch- minimum thick, galvanized-steel or 0.125-inch- minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.

1. Secure blades to 1/2-inch- diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From minus 40 to plus 200 deg F.
3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x lbf; when tested according to AMCA 500D.

2.12 CONTROL VALVES

A. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

B. Terminal Unit Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.

1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
2. Sizing: 3-psig maximum pressure drop at design flow rate, to close against pump shutoff head.

3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

C. Self-Contained Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.

1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
2. Thermostatic Operator: Liquid-filled integral sensor with integral remote adjustable dial.

2.13 PRESSURE-INDEPENDENT CONTROL VALVES

A. Pressure-independent control valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

B. Available Manufacturers:

1. Belimo Aircontrols, Inc.
2. Flow Control Industries, Inc.
3. Griswold Controls

C. Pressure Independent Control Valves

1. The modulating control valves shall be pressure independent.
2. The control valves shall accurately control the flow from 0 to 100% full rated flow with an equal percentage flow characteristic. The flow shall not vary more than +/- 5% due to system pressure fluctuations across the valve with a minimum of 5 PSID across the valve.
3. Forged brass body rated at no less than 400 PSI, chrome plated brass ball and stem, female NPT union ends, dual EPDM lubricated O-rings and TEFZEL characterizing disc.
4. Combination of actuator and valve shall provide a minimum close-off pressure rating of 200 PSID.
5. All actuators shall be electronically programmed by use of a handheld programming device or external computer software.
6. The actuator shall be mounted to the valve at the factory via a mounting-base.
7. The manufacturer shall warrant all components for a period of 5 years from the date of production, with the first two years unconditional.
8. The use of pressure independent valves piped in parallel to achieve the rated coil flow shall be permitted. Actuators shall be electronically programmed to permit sequencing the flow with a single control output point.

2.14 SMOKE DETECTORS

A. Smoke detectors shall be furnished under Division 28 and installed under this Section.

B. Wiring from smoke detectors to fire alarm system shall be under Division 28.

C. Wiring from smoke detectors to mechanical equipment shall be under this Section.

2.15 LOW TEMPERATURE DETECTION STAT: By BAS manufacturer

2.16 CURRENT SENSING RELAYS: By controls contractor for all equipment.

2.17 MISCELLANEOUS RELAYS AND SWITCHES:

A. General: Where required by the sequence of operation switches, relays, and miscellaneous devices necessary to accomplish the sequence shall be provided under this section.

PART 3 - EXECUTION

3.1 PROJECT MANAGEMENT

A. Provide a designated project manager who will be responsible for the following:
1. Construct and maintain project schedule
2. On-site coordination with all applicable trades and subcontractors
3. Authorized to accept and execute orders or instructions from owner/architect
4. Attend project meetings as necessary to avoid conflicts and delays
5. Make necessary field decisions relating to this scope of work
6. Coordination/Single point of contact.

3.2 EXAMINATION

A. Verify that power supply is available to control units and operator workstation.

B. Verify that duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

3.3 INSTALLATION

A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.

B. Connect and configure equipment and software to achieve sequence of operation specified in Section 23 section "Sequences of Control."

C. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices next to light switch(es) when space is available with top of device at 48 inches above finished floor. Where space next to light switch(es) is not available, align device vertically with light switch and locate device with top at 40 inches above the finished floor.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

D. Install automatic dampers according to Division 23 Section "Air Duct Accessories."

E. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

F. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."

G. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.
3. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
4. Test each point through its full operating range to verify that safety and operating control set points are as required.
5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
6. Test each system for compliance with sequence of operation.
7. Test software and hardware interlocks.

C. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check instrument tubing for proper fittings, slope, material, and support.
5. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
6. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
7. Check temperature instruments and material and length of sensing elements.
8. Check control valves. Verify that they are in correct direction.
9. Check DDC system as follows:

    a. Verify that DDC controller power supply is from emergency power supply.
    b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
    c. Verify that spare I/O capacity has been provided.
    d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.5 ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:

    a. Check analog inputs at 0, 50, and 100 percent of span.
    b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
    c. Check digital inputs using jumper wire.
    d. Check digital outputs using ohmmeter to test for contact making or breaking.
    e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.

5. Flow:

    a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
    b. Manually operate flow switches to verify that they make or break contact.

6. Pressure:

    a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
    b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.

7. Temperature:

    a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
    b. Calibrate temperature switches to make or break contacts.

8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
10. Provide diagnostic and test instruments for calibration and adjustment of system.
11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature and humidity set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

END OF SECTION 230900

SECTION 230993 - SEQUENCE OF OPERATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The drawings and general provisions of the Contract Documents apply to this Section.

1.2 SUMMARY

A. This Section includes control sequences for HVAC systems, subsystems, and equipment.

B. Related Sections include the following:

1. Division 23 Section "Building Automation System" for control equipment and devices and for submittal requirements.

1.3 DEFINITIONS

A. BAS: Building Automation System
B. CO_2: Carbon Dioxide
C. DDC: Direct-digital controls.
D. PPM: Parts per million.
E. RPM: Revolutions Per Minute.
F. VAV: Variable air volume.
G. VFD: Variable-Frequency Drive.

1.4 GENERAL REQUIREMENTS OF THIS SECTION

A. Control sequences shall be accomplished in accordance with control drawings and the sequences specified in this section. It is the intent of this section to utilize sequences included in pre-programmed controllers when such sequences provide the intended operation.

B. Points may not be deleted without prior approval from the Architect.

C. Every attempt has been made to indicate all required points on the control drawings. Occasionally an additional point, or points, may be required to accomplish a specified sequence. The contractor performing work under this section shall understand the work to be implied and required by the contract documents. Additional hardware and software required shall be provided under section "Building Automation System" at no additional cost to the owner.

1. Such points include:
   a. Sensors of all types whether or not specified under section "Building Automation System"

b. Flow measuring stations.
c. Wiring, conduit, and related devices such as relays.

2. Exceptions:
   a. Equipment and devices covered under sections other than "Building Automation System".

1.5 DISPLAY GRAPHICS:

A. Include system schematic for each system. Indicate all points in system on at least one graphic.
B. Indicate all commanded values and temperatures.
C. Indicate all sensed temperatures.
D. Indicate all alarms.
E. Indicate all status points.
F. Indicate all monitored conditions.

1.6 WARRANTY

A. Provide all services, materials and equipment necessary for the successful operation of the entire BAS system for a period of one year beginning on the date of substantial completion.

PART 2 - SEQUENCES

2.1 SETPOINTS: Unless indicated otherwise all setpoints shall be adjustable from the head end.

2.2 OCCUPIED / UNOCCUPIED

A. The BAS shall institute occupied and unoccupied control sequences based on a time-of-day schedule furnished by the Owner.

B. The Owner shall have the capability to program holidays and special functions.

C. The owner shall have the ability to override occupied and unoccupied operation of each piece of equipment from the head end.

2.3 OPTIMUM START:

A. The BAS shall institute optimum start strategies for morning warm up and cool down functions. Equipment shall start early enough to restore occupied temperature set-points 30 minutes prior to occupancy.

2.4 OUTSIDE AIR SENSORS:

A. Temperature: The BAS shall monitor outside air temperature as sensed by the outside air temperature sensor.

B. Humidity: The BAS shall monitor outside air relative humidity as sensed by the outside air humidity sensor.

2.5 MAKE-UP AIR UNITS (MAU-01 and MAU-02)

A. General: The Make-Up Air Units are equipped with a variable speed supply fan, variable speed exhaust fan, enthalpy wheel, chilled water cooling coil, hot water heating coil, electrical reactivation coil, and a dessicant wheel. It provides dehumidified outdoor air to chilled beams and fan coil units.

B. Initial Set Points:
   1. General:
      a. Freezestat: 38°F.
      b. Minimum Cooling Coil Discharge Temperature: 50ºF (adjustable)
      c. Initial Heating Coil Discharge Temperature: 70°F (adjustable)
   2. Occupied:
      a. Discharge Dew Point: 43°F (adjustable)
      b. Discharge Cooling Set Point: 68°F
      c. Discharge Heating Set Point: 68°F
      d. Space Relative Humidity: 50% RH (adjustable)
   3. Unoccupied:
      a. Discharge Dew Point: 43°F
      b. Discharge Cooling Set Point: 68°F
      c. Discharge Heating Set Point: 68°F
      d. Space Relative Humidity: 60% RH (adjustable)

C. Enable/Disable:
   1. Occupied Operation: During occupied hours, the unit shall be enabled, the supply and exhaust fans shall be started, the enthalpy and desiccant wheels shall start, and dampers shall modulate in accordance with applicable sequences below.
   2. Unoccupied Operation: During unoccupied hours, the unit shall be disabled, the supply and exhaust fans shall be off, the wheels shall be off, return damper D-1 shall be open, outdoor air damper D-2 shall be closed, exhaust damper D-3 shall be closed, the cooling coil control valve shall be closed, the heating coil control valve shall be fully open, the enthalpy wheel shall be off, and the desiccant wheel shall be off.
      a. Unoccupied Heating: Should the unoccupied space temperature fall below the unoccupied heating space temperature set point, the unit shall be started in the warm-up mode until the space temperature rises 5°F above the unoccupied heating space temperature set point.
      b. Unoccupied Cooling: Should the unoccupied space temperature rise above the unoccupied cooling space temperature set point, the unit shall be started in the cool-down mode until the space temperature falls 5°F below the unoccupied cooling space temperature set point.

c. Unoccupied Humidity Control: If space humidity level (sensed by any of the space humidity sensors) rises above the unoccupied space relative humidity set point, the unit shall operate until the space relative humidity drops 5% RH below the unoccupied space relative humidity set point. If space temperature falls below the occupied heating space temperature set point, the heating coil control valve shall modulate to maintain occupied heating set point.

3. Unoccupied Maintenance Operation: The unit shall operate the same as during occupied operation without outside air.
4. Warm-up Operation: The BAS shall optimize the early start of the unit in warm-up mode to reach the occupied space heating set point by the occupied time. During warm-up the exhaust fan shall remain off, the supply fan shall be ramped up to 100%, the bypass dampers shall be fully open, return damper D-1 shall be fully open, all the other dampers shall be closed, and the heating coil control valve shall open fully.
5. Cool-down Operation: The BAS shall optimize the early start of the unit in cool-down mode to reach the occupied space cooling set point by the occupied time. During cool-down the exhaust fan shall remain off, the supply fan shall be ramped up to 100%, the bypass dampers shall be fully open, the return damper D-1 shall be fully open, all the other dampers shall be closed, and the cooling coil control valve shall open fully.
6. Supply Fan Failure: If the supply fan fails, the unit shall be disabled.
7. Exhaust Fan Failure: If the exhaust fan fails, the unit shall continue to operate with outdoor air and exhaust air dampers closed and the exhaust fan off.

D. Startup: Start time shall be based on the BAS optimum start programming in accordance with a predetermined schedule to be furnished by the Owner and programmed into the BAS. The outside air damper shall remain closed while the unit operates in warm-up/cool-down mode to restore occupied set points. At occupancy time, the BAS shall begin to modulate the outside air damper in accordance with its sequence of control.

E. BAS Failure: In the event of a BAS failure, the chilled beam mixing valve will fail in the off position. When the BAS comes back online, the startup sequence in paragraph 2.5D will occur in order to bring the building back into normal operation.

F. Supply Fan Control:
1. During unoccupied hours, the fan shall be deactivated. The fan shall be started as required to control unoccupied set points.
2. During occupied hours, the BAS shall signal the supply fan to start. The supply fan shall ramp up slowly to design airflow.
3. Drive Malfunction: Should the VFD malfunction as indicated by drive alarm circuit, an alarm shall be sent to the head end. The fan shall continue to operate unless deactivated by the VFDs protection circuitry.

G. Exhaust Fan Control:
1. During unoccupied hours, the fan shall be deactivated. The fan shall be started as required to control unoccupied set points.
2. During occupied hours, the BAS shall signal the exhaust fan to start. The exhaust fan shall ramp up gradually to design airflow.
3. Drive Malfunction: Should the VFD malfunction as indicated by drive alarm circuit, an alarm shall be sent to the head end. The fan shall continue to operate unless deactivated by the VFDs protection circuitry.

H. Heating Coil Control Valve: In cooling mode, the BAS shall close the heating coil control valve to prevent simultaneous cooling and heating. Heating coil operation shall only be available during heating mode.

In heating mode, the heating coil control valve shall modulate to control discharge temperature (as sensed by the temperature sensor downstream of the heating coil). On a fall in space temperature to 2°F below the occupied heating set point, the BAS shall modulate the heating coil control valve open. The valve shall be fully open to the coil at 2°F below set point. On a rise to 1°F above set point, the valve shall close.

I. Cooling Coil Control Valve: In heating mode, the cooling coil control valve shall be closed. During cooling mode, the cooling coil control valve shall modulate to maintain the cooling coil discharge temperature set point (as sensed by the temperature sensor downstream of the cooling coil). On a rise in cooling coil discharge temperature above set point, the BAS shall modulate the cooling coil control valve open. The valve shall be fully open at 2°F above set point. On a fall to 1°F below set point, the valve shall close.

J. Enthalpy Wheel:
1. Occupied: On
2. Unoccupied: Off
3. Alarm: Should the enthalpy wheel motor fail (as sensed by its current sensing relay), an alarm shall be sent to the head end identifying the unit and stating that the enthalpy wheel motor has failed.

K. Enthalpy Wheel Exhaust Air Bypass Damper (D-4):
1. As cooling load drops, the cooling coil control valve shall modulate to maintain the cooling coil discharge air at set point. Once the cooling coil control valve is closed, bypass dampers shall modulate to control the mixed air temperature (as sensed by the mixed air temperature sensor) at the cooling coil discharge temperature set point. At 3°F above the cooling coil discharge temperature set point, the damper shall be fully closed. If the damper does not fully close (as sensed by the damper end switch), an alarm shall be sent to the head end identifying the unit and stating that the bypass dampers have failed to close.

L. Desiccant Wheel:
1. Occupied: On
2. Unoccupied: Off.
3. Alarm: Should the enthalpy wheel motor fail (as sensed by its current sensing relay), an alarm shall be sent to the head end identifying the unit and stating that the enthalpy wheel motor has failed.

M. Reactivation Coil:
1. Occupied: During occupied operation, the reactivation coil control valve shall modulate to maintain the coil discharge set point.
2. Unoccupied: During unoccupied operation, the coil control valve shall be closed.

N. Return Damper (D-1):

1. Unoccupied: Damper shall remain fully open. Damper end switch shall confirm the damper fully open. If the damper fails to open, an alarm shall be sent to the head end identifying the unit and stating that the return air damper D-1 failed to open.
2. Occupied: The BAS shall position the return damper D-1 to provide scheduled minimum outdoor and return airflow (as determined during balancing).

O. Outdoor Air Damper (D-2):
1. Unoccupied: Damper shall remain closed. Damper end switch shall confirm the damper closed. If damper fails to close, an alarm shall be sent to the head end identifying the unit and stating that the outdoor damper failed to close.
2. Occupied: The BAS shall position the outside air damper to provide minimum outdoor airflow (position determined during balancing).

P. Exhaust Air Damper (D-3)
1. Unoccupied: The BAS shall close the damper.
2. Occupied: The BAS shall open the damper. If damper fails to open, an alarm shall be sent to the head end identifying the unit and stating that the exhaust damper failed to open.

Q. Freeze Protection:
1. If the cooling coil entering air temperature (as sensed by the freezestat upstream of the cooling coil) falls to set point, the unit shall be disabled. The outdoor air damper (D-2) and exhaust air damper (D-3) shall close. The cooling coil control valve shall close. The heating coil control valve shall open fully and fail open. The freeze protection mode shall be reset automatically by the BAS when the temperature reaches 5°F above set point.

R. Life Safety: A smoke detector located in the return air duct shall, upon detection of products of combustion, signal the building fire alarm system and shut down the fan. This function shall be manually reset from the unit and shall be so identified on the head-end graphics. An alarm shall also be provided to the BAS head-end.

S. System Safety: Whenever the supply fan is stopped or airflow ceases for any reason (as sensed by the motor status sensing circuit), the supply and exhaust fans shall be deactivated, power to the heating coil hot water control valve shall be removed and the valve shall position open. The outdoor air dampers shall be closed. The exhaust damper shall be closed. The chilled water valve shall be closed. In all modes of operation, commanded position values for all control devices such as dampers and valves shall be readable from the head-end.

T. The BAS shall indicate the following points at the head end via the BACNET interface:

1. Monitoring points:
   a. Operating Condition (Cooling, Heating, Dehumidification)
   b. Mixed air relative humidity.
   c. Mixed air temperature.
   d. Outside air relative humidity.
   e. Outside air temperature.
   f. Return air relative humidity.
   g. Return air temperature.
   h. Supply air relative humidity.
   i. Supply air temperature.
   j. Wheel motor overload.
   k. Rotation switch (once per revolution).
   l. Exhaust air flow.
   m. Enthalpy wheel overload.
   n. Enthalpy wheel rotation sensor.
   o. Supply air flow.
   p. Smoke detector.
   q. Panel switch (Hand/Off/Auto).
   r. Exhaust fan overload.
   s. Supply fan overload.
   t. Chilled water control valve position.
   u. Hot water control valve position.
2. Alarm Points:
   a. Mixed air relative humidity sensor failure alarm.
   b. Mixed air temperature sensor failure alarm.
   c. Outside air relative humidity sensor failure alarm.
   d. Outside air temperature sensor failure alarm.
   e. Return air relative humidity sensor failure alarm.
   f. Return air temperature sensor failure alarm.
   g. Main Air flow alarm.
   h. Exhaust air flow alarm.
   i. Supply fan overload alarm.
   j. Exhaust fan overload alarm.
   k. Enthalpy wheel motor overload alarm.
   l. Enthalpy wheel rotation alarm.
   m. DH wheel motor overload alarm.
   n. DH wheel rotation alarm.
   o. Heat failure alarm.

2.6 ROOFTOP UNIT (RTU-01)

A. The BAS shall enable, disable, and schedule (occupied or unoccupied) the unit through a BACnet interface and the unit will operate under its own controls once enabled. The BAS shall send, at a minimum, the following points to unit:

1. Outdoor air temperature

2. Outdoor air enthalpy. Outdoor air enthalpy shall be calculated using outdoor air temperature and humidity sensors.
3. Static Pressure (as sensed by static pressure sensor located at a point two-thirds of the distance from the supply fan to the end of the longest trunk duct. Avoid sensor locations which result in extreme variations in static pressure due to terminal box operation.)

B. The BAS shall indicate, at a minimum, the following points at the head end via the BACnet interface:

1. Unit Operation Mode
2. DX Coil Leaving Air Temperature
3. Supply Fan Status
4. Exhaust Fan Status
5. Supply fan VFD Speed
6. Exhaust fan VFD Speed
7. Electric Heat Status
8. Electric Heat Capacity
9. Duct Static Pressure
10. Economizer Status
11. Outside Air Damper Position
12. Relief Air Damper Position
13. Return Air Damper Position
14. Supply Air Temperature
15. Return Air Temperature
16. Outside Airflow (CFM)
17. Relief Airflow (CFM)
18. Outside Air Temperature
19. Relief Air Temperature
20. Outside Air After Energy Recovery Temperature
21. Enthalpy wheel overload.
22. Enthalpy wheel rotation sensor.
23. Alarm Points:
    a. Main Air flow alarm.
    b. Exhaust air flow alarm.
    c. Supply fan overload alarm.
    d. Supply fan over-speed alarm.
    e. Exhaust fan overload alarm.
    f. Heat failure alarm.

C. Life Safety: A smoke detector located in the return air duct shall upon detection of products of combustion, signal the building fire alarm system and shut down the unit. This function shall be manually reset from the unit and shall be so identified on the head-end graphics. An alarm shall also be provided to the BAS head-end.

2.7 AIR HANDLING UNITS (AHU-01 AND AHU-02)

A. The BAS shall enable, disable, and schedule (occupied or unoccupied) the unit through a BACnet interface and the unit will operate under its own controls once enabled. The BAS shall send, at a minimum, the following points to unit:

1. Outdoor air temperature
2. Outdoor air enthalpy. Outdoor air enthalpy shall be calculated using outdoor air temperature and humidity sensors.
3. Static Pressure (as sensed by static pressure sensor located at a point two-thirds of the distance from the supply fan to the end of the longest trunk duct. Avoid sensor locations which result in extreme variations in static pressure due to terminal box operation.)

B. The BAS shall indicate, at a minimum, the following points at the head end via the BACnet interface:

1. Unit Operation Mode
2. Chilled Water Coil Leaving Air Temperature
3. Chilled Water Valve Position
4. Supply Fan Status
5. Exhaust Fan Status
6. Supply fan VFD Speed
7. Exhaust fan VFD Speed
8. Hot Water Coil Leaving Air Temperature
9. Hot Water Valve Position
10. Duct Static Pressure
11. Outside Air Damper Position
12. Relief Air Damper Position
13. Return Air Damper Position
14. Enthalpy wheel overload.
15. Enthalpy wheel rotation sensor.
16. Supply Air Temperature
17. Return Air Temperature
18. Outside Airflow (CFM)
19. Relief Airflow (CFM)
20. Outside Air Temperature
21. Relief Air Temperature
22. Outside Air After Energy Recovery Temperature
23. Alarm Points:
    a. Main Air flow alarm.
    b. Exhaust air flow alarm.
    c. Supply fan overload alarm.
    d. Supply fan over-speed alarm.
    e. Exhaust fan overload alarm.
    f. Heat failure alarm.

C. Life Safety: A smoke detector located in the return air duct shall upon detection of products of combustion, signal the building fire alarm system and shut down the unit. This function shall be manually reset from the unit and shall be so identified on the head-end graphics. An alarm shall also be provided to the BAS head-end.

2.8 HORIZONTAL FAN COIL UNITS

A. Initial Setpoints:
   1. Cooling:

a. Occupied: 75° F.
2. Heating:
a. Occupied: 72° F

B. Fan:
1. Occupied: The BAS shall operate the fan continuously.
2. Fan Fail: Should the fan fail to operate (as sensed by the current sensing relay), the BAS shall send a stop command to the fan, close the outside air damper and send an alarm to the head end identifying the fan coil unit by "Number" (FC-01) and stating its fan has failed.

C. Space Temperature Control:
1. Dead Band: The temperature control program shall require a 5° dead band between heating and cooling. When the operator attempts to input heating and cooling setpoints within 5° of each other the operator shall be notified that a 5° dead band is required.
2. Cooling: The BAS shall modulate the cooling coil control valve as required to maintain setpoint.
3. Heating: The BAS shall stage/modulate the hot water control valve as required to maintain setpoint.

D. Drain Pan Overflow: A condensate overflow switch located in the overflow drain line shall disable the fan coil unit. This shall stop the fan and close the control valves. The BAS shall send an alarm to the head end identifying the fan coil unit by "Number" (FC-01), the "Room Served" (As Assigned by the Owner or Architect during construction) and stating the unit drain pan has overflowed.

2.9 CEILING MOUNTED EXHAUST FANS

A. During occupied hours, the BAS shall command the fan on.

B. During unoccupied hours, the BAS shall command the fan off.

C. Fan Fail: Should fan fail to operate (as sensed by the current sensing relay) the BAS shall send a stop command to the fan and send an alarm to the head end identifying the fan and stating that it has failed.

2.10 EXHAUST FAN – CONTROL METHOD BAS SCHEDULE

A. General: These are general duty fans that operate on a time-of-day schedule. Refer to the Fan Schedule for fan information.

B. Occupied/Unoccupied:
1. Unoccupied Operation: During unoccupied hours, the fan shall be off and the damper shall be closed.
2. Occupied Operation: During occupied hours, the fan shall be on and the damper shall be open.

C. Start:

1. At the start of occupied operation, the BAS shall open the motorized damper associated with the fan. Once the damper is confirmed open, the BAS shall start the fan. If the damper is interlocked with fan operation, then the BAS shall start the fan.

D. Stop:
1. At the beginning of unoccupied operation, the BAS shall stop the fan and close the associated damper (or just stop the fan if the damper is interlocked).

E. Fan failure alarm:
1. If the fan fails to start (as sensed by its current sensing relay), an alarm shall be sent to the head end identifying the fan and stating that is has failed to start.

2.11 LIGHTING CONTROLS:

A. Schedule: Lighting shall be signaled off and on in accordance with a schedule provided by the Owner.

B. ON/OFF: To turn lights on the BAS shall temporarily energize the "ON" relay and to turn the lights off the BAS shall temporarily energize the "OFF" relay.

2.12 DOMESTIC HOT WATER TEMPERATURE

A. The BAS shall monitor domestic hot water temperature (as sensed by a temperature sensor located in the hot water supply pipe prior to leaving mechanical room).

B. The BAS shall issue an alarm to the head end if the temperature is more than 5° (adj.) above or below setpoint.

2.13 DOMESTIC HOT WATER PUMP (CP-01)

A. During occupied hours, the BAS shall command the pump off.

B. During occupied hours, the BAS shall command the pump on.

C. Should the pump fail to operate (as sensed by the current sensing relay) the BAS shall send a stop command to the pump and an alarm shall be sent to the head end identifying the pump and starting that it has failed.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230993

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

A. Product Data: For each type of the following:

1. Pipe.
2. Fittings.
3. Joining materials.
4. Bypass chemical feeder.
5. Valves-Include flow and pressure drop curves/information based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow control valves.
6. Air control devices.
7. Chemical treatment.
8. Hydronic specialties.

B. Maintenance Data: For hydronic specialties, balancing valves, automatic flow control valves, and special-duty valves to include in maintenance manuals.

1.3 QUALITY ASSURANCE

A. 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 the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

1.4 COORDINATION

A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate pipe sleeve installations for foundation wall penetrations.

C. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Sections.

D. Coordinate pipe fitting pressure classes with products specified in related Sections.

E. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.

F. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 7 Section "Penetration Firestopping Systems" for fire and smoke wall and floor assemblies.

1.5 BUILDING AUTOMATION SYSTEM COORDINATION:

A. If indicated, all wells, valves, taps, dampers, flow stations, etc. furnished under Section "Building Automation System" shall be installed under this Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping, components, and installation shall withstand the following minimum working pressure and temperature unless otherwise indicated: 150 psig at 200 degrees F.

2.2 COPPER TUBE AND FITTINGS

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

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K. (underground installations)

C. DWV Copper Tubing: ASTM B 306, Type DWV.

D. Grooved, Mechanical Joint, Wrought-Copper Fittings: ASME B16.22.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anvil.
   b. Gruvlok.
   c. Victaulic Company.

2. Grooved end, Copper Fittings: ASTM B75, copper tube or ASTM B584, bronze casting.
3. Grooved end Tube Couplings: Rigid pattern unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, [**prelubricated**] EPDM gasket rated for minimum 230 deg F for use with housing, and steel bolts and nuts.

E. Copper or Bronze Pressure-Seal Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Elkhart Products Corporation.

b. Mueller Streamline Co.
c. NIBCO, Inc.
d. Victaulic Company.
e. Viega, LLC.

2. Housing: Copper
3. O-Rings and Pipe Stops: EPDM.
4. Tools: Manufacturer's special tools.
5. Minimum 200 psig working pressure rating at 250°F.

F. Wrought-Copper Fittings and Unions: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "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. Anvil.
   b. Gruvlok.
   c. Victaulic Company.

2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106/A 106M, 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. Stainless steel nut and bolt hardware for chilled water piping, carbon steel nut and bolt hardware for all others.

3. Couplings: Ductile- or malleable-iron housing and [**EPDM**] [**or**] [**nitrile**] gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

I. Flexible Connectors: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig minimum working pressure and 250 deg F maximum operating temperature. Connectors shall have flanged or threaded-end connections to match equipment connected and shall be capable of 3/4-inch misalignment.

J. Spherical, Rubber, Flexible Connectors: Fiber-reinforced rubber body with steel flanges drilled to align with Classes 150 and 300 steel flanges; operating temperatures up to 250 deg F and pressures up to 150 psig.

K. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.4 PLASTIC PIPE AND FITTINGS

A. CPVC Plastic Pipe: ASTM F 441/F 441M, with wall thickness as indicated in "Piping Applications" Article.

1. CPVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM F 438 for Schedule 40 pipe; ASTM F 439 for Schedule 80 pipe.

B. PVC Plastic Pipe: ASTM D 1785, with wall thickness as indicated in "Piping Applications" Article.

1. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

2.5 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

F. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Solvent Cements for CPVC Piping: ASTM F 493.

1. Verify solvent cement has a VOC content of 490 g/L or less.

H. Solvent Cements for PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

1. Verify solvent cement has a VOC content of 550 g/L or less.

2.6 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:

1. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.

B. Plastic-to-Metal Transition Unions:

1. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.

2.7 DIELECTRIC FITTINGS

B. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

C. Dielectric Unions:

1. Available Manufacturers:
   a. Capitol Manufacturing Company.
   b. Matco-Norca.
   c. Watts Water Technologies, Inc.
   d. Zurn Industries, LLC.

2. Description:

a. Standard: ASSE 1079.
b. Pressure Rating: 150 psig.
c. End Connections: Solder-joint copper alloy and threaded ferrous.

D. Dielectric Flanges:

1. Available Manufacturers:
   a. Capitol Manufacturing Company.
   b. Matco-Norca.
   c. Watts Water Technologies, Inc.
   d. Zurn Industries, LLC.

2. Description:
   a. Standard: ASSE 1079.
   b. Factory-fabricated, bolted, companion-flange assembly.
   c. Pressure Rating: 150 psig.
   d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

E. Dielectric-Flange Insulating Kits:

1. Available Manufacturers:
   a. Advance Products and Systems, Inc.
   b. Calpico, Inc.
   c. Central Plastics Company.
   d. Pipeline Seal and Insulator, Inc.

2. Description:
   a. Nonconducting materials for field assembly of companion flanges.
   b. Pressure Rating: 150 psig.
   c. Gasket: Neoprene or phenolic.
   d. Bolt Sleeves: Phenolic or polyethylene.
   e. Washers: Phenolic with steel backing washers.

F. Dielectric Nipples:

1. Available Manufacturers:
   a. Elster Perfection Corporation.
   b. Grinnell Mechanical Products.
   c. Matco-Norca.
   d. Precision Plumbing Products, Inc.

2. Description:
   a. Standard: IAPMO PS 66.
   b. Electroplated steel nipple, complying with ASTM F 1545.
   c. Pressure Rating: 300 psig at 225 deg F.
   d. End Connections: Male threaded.
   e. Lining: Inert and noncorrosive, propylene.

2.8 VALVES

A. Valves are specified in Division 23 Section "General-Duty Valves for HVAC Piping."

B. Refer to Part 3 "Valve Applications" Article for applications of each valve.

C. Calibrated Balancing Valves:

1. Available Manufacturers:

a. NIBCO
b. Armstrong Pumps, Inc.
c. Flow Design, Inc.
d. Griswold Controls.
e. ITT Bell & Gossett; ITT Fluid Technology Corp.
f. Nexus Valve.
g. NuTech Hydronic Specialty Products
h. Taco, Inc.

2. NPS 2 and Smaller: Bronze body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having threaded ends. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.
3. NPS 2-1/2 and Larger: Cast-iron or steel body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having flanged connections. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.

D. Pressure-Reducing Valves: Diaphragm-operated, bronze or brass body with low inlet pressure check valve, inlet strainer removable without system shutdown, and noncorrosive valve seat and stem. Select valve size, capacity, and operating pressure to suit system. Valve shall be factory set at operating pressure and have capability for field adjustment.

E. Pressure Relief Valves and Temperature & Pressure Relief Valves:

1. Available Manufacturers

a. Amtrol, Inc.
b. Armstrong Pumps, Inc.
c. Conbraco Industries, Inc.
d. ITT McDonnell & Miller Div.; ITT Fluid Technology Corp.
e. Kunkle Valve Division.
f. NuTech Hydronic Specialty Products
g. Spence Engineering Company, Inc. Pressure-Reducing Valves:
h. Watts Industries, Inc.; Watts Regulators.

2. Diaphragm-operated, bronze or brass body with brass and rubber, wetted, internal working parts; shall suit system pressure and heat capacity and shall comply with the ASME Boiler and Pressure Vessel Code, Section IV.

F. Automatic Flow-Control Valves:

1. Manufacturers:

a. Bell & Gossett
b. Flow Design, Inc.
c. Griswold Controls
d. Hays Fluid Controls
e. Nexus Valve
f. NuTech Hydronic Specialty Products
g. Pro Hydronic Specialties

2. Factory set to maintain constant flow with plus or minus 10 percent over system pressure fluctuations. Each valve shall have an identification tag attached by chain, and be factory marked with the zone or equipment identification, valve number, and flow rate. Valve shall be line size and as follows:

a. Gray-iron or brass body, designed for 175 psig at 200 deg F or; brass or ferrous-metal body, designed for 300 psig at 250 deg F.
b. Stainless steel or nickel chrome plated brass, tamperproof, self-cleaning, piston-spring assembly, or polyphenylsulfone orifice seat with polymer diaphragm (Hays) easily removable for inspection or replacement.
c. "Y" or other configuration permitting cartridge replacement without valve removal for sizes 2" and smaller.
d. Unions and isolation valves or other configuration permitting cartridge replacement with valve removal for sizes larger than 2".
e. Flow and pressure differential adjustable by cartridge replacement.
f. Minimum pressure differential shall not exceed 2 psi. (Unless otherwise indicated)
g. Maximum pressure differential shall not be less than 32 psi. (Unless otherwise indicated)
h. Flow rates shall be as indicated on equipment schedules on the drawings.
i. Valves shall be installed in return piping.
j. Ball valves and unions included as part of a valve package may be used in place of ball valves and unions specified and indicated on the drawings only when in positions indicated. Ball valves shall be provided with a solid stainless-steel ball.
k. Provide a #20 mesh Y-strainer with blow-down valve and garden hose connection between the supply side valve and equipment
l. Valves may be provided as part of a "hose kit" and are exempt from the requirements of section "General Duty Valves for HVAC Piping".

2.9 AIR CONTROL DEVICES

A. Available Manufacturers:

1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. Bell & Gossett Domestic Pump; a division of ITT Industries.
4. Nexus Valve.
5. NuTech Hydronic Specialty Products

6. Taco.

B. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2
5. Discharge Connection: NPS 1/8
6. CWP Rating: 150 psig
7. Maximum Operating Temperature: 225 deg F

C. Automatic Air Vent: Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150-psig working pressure; 240 deg F operating temperature; with NPS 1/4 discharge connection and NPS 1/2 inlet connection.

2.10 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers: 125-psig working pressure; cast-iron body (ASTM A 126, Class B), flanged ends for NPS 2-1/2 and larger, threaded connections for NPS 2 and smaller, bolted cover, perforated stainless-steel basket, and bottom drain connection.

B. Basket Strainers: 125-psig working pressure; high-tensile cast-iron body (ASTM A 126, Class B), flanged-end connections, bolted cover, perforated stainless-steel basket, and bottom drain connection.

C. Flexible Connectors:

1. Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig minimum working pressure and 250 deg F maximum operating temperature. Connectors shall have flanged- or threaded-end connections to match equipment connected and shall be capable of 3/4-inch misalignment.
2. Spherical, Rubber, Flexible Connectors: Fiber-reinforced rubber body with steel flanges drilled to align with Classes 150 and 300 steel flanges; operating temperatures up to 250 deg F and pressures up to 150 psig.

D. Pressure temperature test (P/T) port

1. Manufacturers:

a. NuTech Hydronic Specialty Products
b. Petersen
c. Sisco Manufacturing Co.
d. Omega
e. Watts Water Technologies, Inc.

2. Body: Brass.
3. Core: Nordel
4. Cap: Brass

5. Provide extension to allow insulation installation.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Heating Hot Water, Chilled Water, Heat Pump Loop Water, and Condenser Water NPS 2 and Smaller:

1. Aboveground shall be either:

a. Type L drawn-temper copper tubing with wrought-copper fittings and [**soldered**] [**or pressure-seal**] joints.
b. Schedule 40, Grade B steel pipe; Class 125 cast iron or Class 150 malleable iron fittings; cast iron flanges and flange fittings; and threaded joints.

2. Belowground and below slabs:

a. Type K annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.

B. Heating Hot Water, Chilled Water, Heat Pump Loop Water, and Condenser Water NPS 2-1/2 and Larger:

1. Inside building and aboveground:

a. Schedule 40 steel pipe, wrought steel fittings and wrought cast or forged steel flanges and flange fittings, and welded and flanged joints.
b. Type L, drawn-temper copper tubing, wrought copper fittings, and soldered joints or mechanical-joint couplings.
c. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints. Chilled water piping shall use stainless steel bolt and nut hardware.

2. Belowground and below slabs:

a. Type K annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use fewest joints possible.
b. Schedule 80 CPVC plastic pipe and fittings and solvent-welded joints.

C. Chilled Water, Heat Pump Loop Water, and Condenser Water 2-1/2" and Larger Outside Building: As specified for Inside Building,

D. Make-up Water 2" and Smaller:

1. Aboveground: Type L drawn-temper copper tubing with wrought-copper fittings, and soldered joints.

2. Belowground: Type K, annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.

E. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints or Schedule 40 PVC or CPVC plastic pipe and fittings with solvent-welded joints.

1. Exceptions where PVC, CPVC, and other forms of plastic are not permitted:

a. Jails/Prisons.
b. Plenums.
c. Locations prohibited by codes or standards.

F. Air-Vent Piping:

1. Inlet: Same as service where installed.
2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

G. Safety-Valve-Inlet and -Outlet Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

H. Miscellaneous: Same materials and joining methods as connecting service.

3.2 VALVE APPLICATIONS

A. General-Duty Valve Applications: Unless otherwise indicated, use the following valve types:

1. Shutoff Duty: Ball, and butterfly valves.
2. Throttling Duty: Ball, and butterfly valves.

B. Install shutoff duty valves at each branch connection to supply mains, unless only one piece of equipment is connected in the branch lines, and at supply connections to each piece of equipment. Install manual flow control device where indicated at branch piping.

C. Install Automatic Flow Control Valves in the return water line of each heating or cooling coil, and as indicated.

D. For parallel chillers or boilers without dedicated primary pumps, provide manual balancing valves in the return line at full piping size and with low pressure drop. Do not use automatic flow control valves in these applications.

E. Install check valves at each pump discharge and elsewhere to control flow direction.

F. Install safety valves on hot-water generators and as required by the ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping without valves. Comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

G. Install pressure-reducing valves on makeup water piping to regulate system pressure.

3.3 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 in writing on Coordination Drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and 8" NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. 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.

O. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

P. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

Q. Install shutoff valve immediately upstream of each dielectric fitting.

R. Install all wells, valves, taps, flow stations, etc. furnished under Section "Building Automation System."

S. Install exterior piping at a uniform grade of 0.2 percent upward in direction of flow. Interior piping may be installed level.

T. Install condensate drain piping at a minimum uniform slope of 1" in 10'-0"in the direction of flow.

U. Reduce pipe sizes using concentric reducers, or eccentric reducers installed with level side up.

V. Provide branch connections with the takeoff coming off the top of the main.

W. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and as indicated. Install 3/4" diameter by 8" long nipple and ball valve in blowdown connection of strainers 3/4" and larger. Match size of strainer blow-down connection for strainers smaller than 3/4".

X. Provide seal around piping penetrations of full height interior walls, both rated and non-rated, that occur above ceilings. Refer to Section 079200 Joint Sealants.

Y. Where piping penetrates a non-fire-resistance-rated floor or floor/ceiling assembly or ceiling membrane of a non-fire-resistance-rated roof/ceiling assembly, provide the following:

1. For noncombustible piping that connects not more than five stories, protect the annular space around the piping with an approved, noncombustible material to resist the free passage of flame and the products of combustion or with a tested and classified through-penetration firestop system.
2. For piping that connects not more than two stories, protect the annular space around the piping with an approved, noncombustible material to resist the free passage of flame and the products of combustion.
3. For piping that penetrates a non-rated wall, protect the annular space around the penetrating piping with an approved, non-combustible materials that resists the free passage of flame and the products of combustion.

3.4 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are damaged.
3. Damaged Welds: Do not use pipe sections that have cracked or open welds.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned.

H. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Non-pressure Piping: Join according to ASTM D 2855.

I. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

3.5 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports." Comply with requirements below for maximum spacing of supports.

B. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. ¾": Maximum span, 7'-0"; minimum rod size, ¼".
2. 1": Maximum span, 7'-0"; minimum rod size, ¼".
3. 1½": Maximum span, 9'-0"; minimum rod size, 3/8".
4. 2": Maximum span, 10'-0"; minimum rod size, 3/8".
5. 2½": Maximum span, 11'-0"; minimum rod size, 3/8".
6. 3": Maximum span, 12'-0"; minimum rod size, 3/8".
7. 4": Maximum span, 14'-0"; minimum rod size, ½".
8. 6": Maximum span, 17'-0"; minimum rod size, ½".
9. 8": Maximum span, 19'-0"; minimum rod size, 5/8".
10. 10": Maximum span, 20'-0"; minimum rod size, ¾".
11. 12": Maximum span, 23'-0"; minimum rod size, 7/8".
12. 14": Maximum span, 25'-0"; minimum rod size, 1".
13. 16": Maximum span, 27'-0"; minimum rod size, 1".
14. 18": Maximum span, 28'-0"; minimum rod size, 1¼".

15. 20": Maximum span, 30'-0"; minimum rod size, 1¼".

C. Where hangers for steel piping are to be suspended from open-web steel joists, install hangers at maximum spacing that will result in hanger loads that comply with the requirements on the structural drawings.

D. Install hangers for copper piping with the following maximum spacing and minimum rod sizes:

1. ¾": Maximum span, 5'-0"; minimum rod size, ¼".
2. 1": Maximum span, 6'-0"; minimum rod size, ¼".
3. 1½": Maximum span, 8'-0"; minimum rod size, 3/8".
4. 2": Maximum span, 8'-0"; minimum rod size, 3/8".
5. 2½": Maximum span, 9'-0"; minimum rod size, 3/8".
6. 3": Maximum span, 10'-0"; minimum rod size, 3/8".

E. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.6 Where changes in direction or tees occur, place hangers 1/3 of the maximum allowed spacing distance from the change in direction or tee (i.e. if the maximum span is 12 feet, the hanger shall be 4feet from the change in direction or tee). Pipe shall be supported from both sides of a change in direction.

3.7 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at coils, and elsewhere as required for system air venting.

B. [Install automatic air vents in mechanical equipment rooms only at high points of system for air venting.]

C. Install in-line air separators in pump suction lines. Install piping to compression tank with a 2 percent minimum upward slope toward tank.

1. Install drain valve on units NPS 2 and larger.

D. [Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches above floor. Install feeder in bypass line, off main, using globe valves on each side of feeder and in the main between bypass connections. Pipe drain, with ball valve, to nearest equipment drain.]

E. Install expansion tanks on floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system design requirements.

3.8 TERMINAL EQUIPMENT CONNECTIONS

A. Size for supply and return piping connections shall be ¾" or match equipment connection size or as indicated on the drawings, whichever is greater.

B. Install control valves in accessible locations near connected equipment.

C. Install ports for pressure and temperature gages at equipment and coil inlet and outlet connections.

3.9 CHEMICAL TREATMENT

A. Flush system with fresh clear water until it drains clear.

B. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.

C. Provide initial water treatment.

3.10 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 testing.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush system with clean water. Clean strainers.
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.
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 trapped air. Use drains installed at low points for complete draining of liquid.
3. Check expansion tanks to determine that they are not air bound and that system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure or a minimum of 100 psi whichever is greater. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test.
5. After hydrostatic test pressure has been applied for at least 15 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.

3.11 ADJUSTING

A. Mark calibrated nameplates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.

B. Perform these adjustments before operating the system:

1. Open valves to fully open position. Close coil bypass valves.
2. Check pump for proper direction of rotation.
3. Set automatic fill valves for required system pressure.
4. Check air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils and equipment are calling for full flow.
6. Check and set equipment operating temperatures to design requirements.
7. Lubricate motors and bearings.

3.12 CLEANING

A. Remove and clean or replace strainer screens. After cleaning and flushing hydronic piping systems, but before balancing, remove disposable fine-mesh strainers.

END OF SECTION 232113

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 PERFORMANCE REQUIREMENTS

A. Seal all ducts to seal class A as defined in SMACNA's HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020:

1. Seal all longitudinal joints.
2. Seal all transverse joints.
3. Seal all penetrations.

B. Seal Class: A

C. Test pressure for medium-pressure supply ductwork:

1. 3.0" WC for round and flat oval duct.
2. 3.0" WC for rectangular duct.

D. Testing: Leak test all ductwork operating at 3.0" WC or greater.

E. Duct Construction: 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, Fourth Edition 2020" and performance requirements and design criteria indicated in "Duct Schedule" Article.

F. Liner Airstream Surfaces: Liner surfaces in contact with the airstream shall comply with ASHRAE 62.1, paragraph 5.5.

G. Cleanliness: All factory fabricated duct shall be cleaned with a non-toxic, biodegradable cleaner/degreaser and shall be shrink wrapped prior to shipment.

1.3 DEFINITIONS:

A. Duct System: For the purposes of this section "duct system" shall mean all metal supply, return, and exhaust duct and fittings between the air moving device and the space.

B. Low Pressure: Plus two (2.0) inches WC to minus one (1.0) inches WC

C. Medium Pressure: More than two (2.0) inches WC to plus ten (10.0) inches WC or more than minus one (1.0) inch to minus ten (10.0) inches WC

D. High Pressure: More than plus or minus ten (10.0) inches WC.

1.4 SUBMITTALS

A. Product Data / Documentation: For each of the following:

1. Sheet metal thicknesses.
2. Liners and adhesives.
3. Pre-manufactured ductwork.
4. Sealants and gaskets.
5. VOC content for adhesives and sealants.
6. Seismic-restraint devices.

B. Submittals during construction:

1. Leakage Test Report: Documentation of work performed for compliance with ASHRAE/IESNA 90.1, Section 6.4.4.2.2 - "Duct Leakage Tests."
2. Duct-Cleaning Test Report: Documentation of work performed for compliance with ASHRAE 62.1, Section 7.2.4 - "Ventilation System Start-Up."

1.5 QUALITY ASSURANCE

A. Provide work in compliance with applicable Building Code requirements.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

C. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.

D. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.

E. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

F. ASHRAE Compliance: Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

G. ASHRAE/IESNA Compliance: Comply with applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020" 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, Fourth Edition 2020," Figure 2-1, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," 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, Fourth Edition 2020."

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, Fourth Edition 2020," 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, Fourth Edition 2020."

2.2 LOW PRESSURE SINGLE-WALL ROUND DUCTS AND FITTINGS –CONCEALED

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Chapter 3, "Round, Oval, and Flexible Duct," based on specified static-pressure class unless otherwise indicated.

B. Snap Lock Round Pipe with External Duct Sealant

1. Provide ASTM A653 hot-dipped, galvanized steel sheet, 26 gauge, G-60 coating. Product shall meet pressure rating of -1" wg to +2" wg.
2. Comply with SMACNA Class 3 Leakage standards and SMACNA Seal Class A with external, field-applied, mastic duct sealant.

C. Snap Lock Round Pipe with Factory Duct Seal

1. Available Manufacturers:
   a. GreenSeam Industries - GreenSeam Plus

2. Provide ASTM A653 hot-dipped, galvanized steel sheet, 26 gauge, G-60 coating. Product shall meet pressure rating of -1" wg to +2" wg.
3. Comply with SMACNA Class 3 Leakage standards and SMACNA Seal Class A with transverse and longitudinal seams sealed with factory-provided EPDM rubber and co-polymer gaskets.

D. Round Duct Manufacturers:

1. Eastern Sheet Metal.
2. Hamlin Sheet Metal.
3. Linx Industries - Lindab.
4. McGill AirFlow LLC.
5. MKT Metal Manufacturing
6. Semco, Inc.
7. Sheet Metal Connectors, Inc.
8. Spiral Manufacturing Co., Inc.

E. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 3-1, "Round Duct Transverse Joints"

1. Transverse Joints in Ducts Equal to or Larger Than 48" in Diameter: Flanged.
2. Gasketed, EPDM, self-sealing Joints such as Eastern Tight or Spiro Safe may be used for ducts smaller than 48" in diameter.
3. Flanges may be substituted in ducts smaller than 48" in diameter.

F. Duct support intervals, and other provisions: In accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020."

G. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 3-2, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020."

H. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 3-5, "90º 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, Fourth Edition 2020." Adjustable elbows are not permitted.

I. All round duct shall not be less than 26-gauge.

2.3 MEDIUM PRESSURE SINGLE-WALL ROUND DUCTS AND FITTINGS –CONCEALED

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

B. Manufacturers:

1. Eastern Sheet Metal.
2. Hamlin Sheet Metal.
3. Linx Industries - Lindab.
4. McGill AirFlow LLC.
5. MKT Metal Manufacturing
6. Semco, Inc.
7. Sheet Metal Connectors, Inc.
8. Spiral Manufacturing Co., Inc.

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 3-1, "Round Duct Transverse Joints"

1. Transverse Joints in Ducts Equal to or Larger Than 48" in Diameter: Flanged.
2. Gasketed, EPDM, self-sealing Joints such as Eastern Tight or Spiro Safe may be used for ducts smaller than 48" in diameter.
3. Flanges may be substituted in ducts smaller than 48" in diameter.

D. Duct support intervals, and other provisions: In accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020."

E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020."

F. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 3-5, "90º 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, Fourth Edition 2020." Adjustable elbows are not permitted.

G. All seam types in Figure 3-2 are acceptable where approved by SMACNA.

H. All round duct shall not be less than 26-gauge.

2.4 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M.

D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 316, cold rolled, annealed, sheet. Exposed surface finish shall be No. 4.

E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. 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.

H. 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.

2.5 DUCT LINER

A. For double wall duct: Not required. All other duct: Provide where indicated.

B. 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:

a. CertainTeed Corporation.
b. Johns Manville.
c. Knauf Insulation.
d. Owens Corning.

2. Maximum Thermal Conductivity:

1) Type I, Flexible: 0.26 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

3. For supply ductwork, provide antimicrobial, erosion-resistant coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

C. Natural-Fiber Duct Liner: 85 percent cotton, 10 percent borate, and 5 percent polybinding fibers, treated with a microbial growth inhibitor and complying with NFPA 90A or NFPA 90B.

1. Manufacturers:

a. Ductmate Industries, Inc.

2. Maximum Thermal Conductivity: 0.24 Btu x in./h x sq. ft. x deg F at75 deg F mean temperature when tested according to ASTM C 518.
3. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to ASTM E 84; certified by an NRTL.
4. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

D. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

E. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.

6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

    a. Fan discharges.
    b. Intervals of lined duct preceding unlined duct.
    c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.

F. 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.

2.6 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723.

1. Materials: Certified by a NRTL.

B. Tape sealing systems are not permitted.

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
10. Indoor applications: Sealant with VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
11. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
12. Service: Indoor or outdoor.
13. Substrate: Compatible with galvanized sheet steel, stainless steel, or aluminum sheets.

D. 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. Indoor applications: Sealant with VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.7 HANGERS AND SUPPORTS

A. Hanger Rods: Galvanized, all-thread.

B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

D. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

E. 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.

F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

G. 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.

2.8 SEISMIC-RESTRAINT DEVICES

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

1. Cooper B-Line, Inc.; a division of Cooper Industries.
2. Ductmate Industries, Inc.
3. Hilti Corp.
4. Kinetics Noise Control.
5. Mason Industries.
6. TOLCO; a brand of NIBCO INC.
7. Unistrut Corporation; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: Shop-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

D. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

E. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved by Architect in writing.

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020" unless otherwise indicated.

C. Install ducts with fewest possible joints.

D. Install factory-fabricated fittings for changes in direction, size, and shape and for branch connections.

E. Unless otherwise indicated, install ducts vertically or horizontally, and parallel or perpendicular to building lines.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Maintain clearances for equipment maintenance.

G. Install ducts with a clearance of 1 inch, plus allowance for installation of insulation at specified thickness.

H. Do not route ducts through transformer vaults, electrical equipment rooms, elevator equipment rooms or electrical enclosures.

I. 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.

J. Provide fire dampers where ducts pass through fire-rated interior partitions, fire-rated exterior walls, fire-rated floor assemblies, or fire-rated shaft enclosures.

K. Protect duct interiors from moisture, construction debris, dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines" 2000 edition, for protection, cleaning, and installation methods for all ductwork. Adhere to the requirements for a duct cleanliness level of "C" (advanced level) as detailed in Section 3 of the guidelines.

3.2 PROTECTION OF WALL AND FLOOR PENETRATIONS OF NON-RATED ASSEMBLIES

A. Where ducts penetrate non-fire-resistance-rated wall or floor assemblies, protect the penetration with one of the following:

1. For a duct that connects not more than two stories vertically, protect the annular space around the penetrating duct with an approved, noncombustible material that resists the free passage of flame and the products of combustion.
2. For a duct that connects not more than three stories, protect the annular space around the penetrating duct with an approved, noncombustible material that resists the free passage of flame and the products of combustion and a fire damper at each floor line.
3. For ducts that penetrate a smoke partition without a smoke damper, protect the annular space around the penetrating duct with an approved, non-combustible materials that resists the free passage of flame and the products of combustion.
4. For ducts that penetrate a non-rated wall, protect the annular space around the penetrating duct with an approved, non-combustible materials that resists the free passage of flame and the products of combustion.

3.3 DUCT SEALING

A. Seal all ducts to seal class A as defined in SMACNA's HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020:

1. Seal all longitudinal joints.
2. Seal all transverse joints.
3. Seal all penetrations.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Chapter 5, "Hangers and Supports."

B. Building Attachments: Unless indicated otherwise, provide 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. Do not use powder-actuated concrete fasteners for lightweight-aggregate concrete or for slabs less than 4 inches thick.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," 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 channel supports.

E. Support vertical ducts with channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor or at a maximum interval of 18 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Design hangers and braces to support the duct and to restrain against seismic forces required by applicable building codes. Comply with ASCE/SEI 7 and brace changes of direction longer than 12 feet.

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

F. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect 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, and grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Install heavy-duty sleeve anchors with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.6 CONNECTIONS

A. Make connections to equipment with flexible connectors.

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020" for branch, outlet, inlet, and terminal unit connections unless otherwise indicated.

3.7 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply two coats of flat black, latex paint over a compatible galvanized-steel primer.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Visually inspect, for proper seal application, all ductwork not tested prior to insulation application. Prepare inspection report.

C. Leakage Test. Test ducts with operational pressures greater than or equal to 3" WC.

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Prepare a report for each test.
2. Test ducts, disassemble, reassemble, reseal, and retest until leakage class 3 (as defined in SMACNA's HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020) is achieved.
3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested.
6. Give seven days' advance notice to Architect and Owner for testing.

D. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present. If visible contaminants are present, proceed to sub-paragraph 2 below. If not, no further cleaning shall be required.
2. Test sections of metal duct systems, up to one location per ten thousand (10,000) square feet of building area, or a minimum of two (2) per system, whichever is greater, chosen by the Owner's Representative, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems." Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm. Cut hole in duct and install access door at each location selected. Size shall be as indicated in Division 23 Section "Air Duct Accessories."
3. Duct system shall be considered dirty and in need of cleaning if any test location does not pass the cleanliness test. Cleaning shall be performed in accordance with this specification.

E. Prepare and submit test and inspection reports.

3.9 DUCT CLEANING

A. Clean new duct systems before testing, adjusting, and balancing.

B. Comply with SMACNA "Duct Cleanliness for New Construction Guidelines" dated 2000, for protection, cleaning, and installation methods for all ductwork. Adhere to the requirements for a duct cleanliness level of "C" (advanced level) as detailed in Section 3.11.

3.10 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Transfer Duct Liner (where indicated): 1" thickness.

C. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 4-2, "Rectangular Elbows."
    a. Velocity less than 1500 fpm or lower:
        1) Radius Type RE 1. Centerline radius = 3W/2.
        2) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
        3) Transfer ducts indicated with mitered elbows do not require turning vanes.
    b. Velocity 1500 fpm or Higher:
        1) Radius Type RE 3. Centerline radius = 3w/2 and three vanes.
        2) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 3-4, "Round Duct Elbows."
    a. Minimum centerline radius-to-diameter ratio shall be 1.5 with a maximum of 5 Elbow Segments. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Table 3-1, "Mitered Elbows." Elbows with less than a 90 degree change of direction shall have segments per Table 3-1 in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020".
    b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped, segmented, spiral or pleated. Adjustable elbows not acceptable.
    c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam, segmented, or spiral.
3. Flat Oval Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 3-7, "Flat Oval Ducts" for elbows.

D. Branch Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 4-6, "Branch Connections."
    a. Rectangular Main to Rectangular Branch: 45-degree entry.
    b. Rectangular Main to Round Branch: Conical or bell mouth. No flanged or spin-in fittings permitted.
2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Fourth Edition 2020," Figure 3-6, "Conical Tees."
    a. Conical fitting.
    b. Conical saddle taps.
    c. No 90 degree taps or 90 degree saddle taps permitted.

E. Divided Flow Branches:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible, Fourth Edition 2020, "Figure 4-5 Divided Flow Branches."

3.12 Duct Pressure Classes:

A. Supply ducts from rooftop units to terminal units: 3 inches WC.

B. Supply ducts from rooftop units to air terminals: As indicated in rooftop unit schedule.

C. Supply ducts from terminal units to air terminals: 1 inch WC.

D. Return ducts: 1 inch WC.

E. Exhaust ducts: 2 inch WC.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

A. Product Data: For the following:

1. Radius forming braces
2. Volume dampers.
3. Motorized control dampers.
4. Backdraft dampers
5. Flange connectors.
6. Turning vanes.
7. Flexible connectors.
8. Flexible ducts.

B. Wiring Diagrams: For power, signal, and control wiring.

C. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

C. Comply with SMACNA standards for manual airflow regulators (dampers).

1.4 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed. Minimum 1 of each type used.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise

indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable duct installation methods unless otherwise indicated.

C. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60
2. Exposed-Surface Finish: Mill phosphatized.

D. 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.

E. 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.

F. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

G. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

H. 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; compatible materials for aluminum and stainless-steel ducts.

2.2 RADIUS FORMING BRACES

A. Available manufacturers:

1. Titus, FlexRight (Basis of Design)
2. Flexible Technologies, Inc., Thermaflex Division, FlexFlow
3. Hart & Cooley, Smart Flow Elbow

B. General: UL-2043 listed or NRTL approved product constructed of metal or plastic manufactured for use with flexible duct to form a kink free elbow using the flexible duct. Any flexible duct used in forming the elbow shall be included in the maximum permitted length. Resulting flexible duct shall comply with SMACNA HVAC Duct Construction Standards.

C. Duct Size: 6" through 16" in diameter.

D. Inside (Bend) Radius: Minimum of one duct diameter along centerline.

E. Attachments: Plastic zip ties or stainless steel worm gear clamps.

F. Support to Overhead: Shall meet SMACNA requirements. Use of specified attachments for support shall not be permitted.

2.3 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Suitable for horizontal or vertical applications.

2. Locking Hardware Component: Everlock damper handle by Rossi.

a. Bracket: Cold Rolled Steel (ASTM A-1008), 18-gauge nominal thickness. Single cut and formed bracket for use with 1.5" or 2.0" insulation wrapping or any other such stand-off applications. Finished with a white Chromate plating process.
b. Handle and Thumb Trigger: Polyamide 66 (PA66), flame retardant, glass reinforced, "Zytel," from Dupont.
c. Compression Spring: Stainless steel type 302-OD 0.25 wire 0.026 free length of 7/8" (0.875").
d. Retaining Spring: Ext. self-lock TX-75ST-ZF Carbon Steel SAE 1074 with Zink Bright Plating. C-Scale Rockwell Hardness 47 to 51.

3. Blades (or Discs):

a. 4" to 16" Diameter single blade (or disc). ASTM-A527 LFO G90, 22 gauge reinforced to equal strength of 20-gauge material.
3/8" Full length bar fits through formed channel in center of damper blade.

4. Bars: 3/8" square Aluminum bar

5. Bearings:

a. Snap-in bearings by Rossi for medium and low pressure systems. Polyamide 66 (PA66), Flame Retardant, Glass Reinforced, "Zytel" by Dupont.
b. Clip-on bearings by Rossi for higher pressure systems. Polyamide 66 (PA66), Flame Retardant, Glass Reinforced, "Zytel" by Dupont.
c. B-Lined bearings by Rossi for lined duct. Polyamide 66 (PA66), Flame Retardant, Glass Reinforced, "Zytel" by Dupont.

B. Damper Hardware for Other Dampers:

1. Locking Hardware Component: Everlock damper handle by Rossi.

a. Bracket: Cold Rolled Steel (ASTM A-1008), 18-gauge nominal thickness of 0.0478 with tolerance range of 0.0438 to 0.0518. Single cut and formed bracket for use with 1.5" or 2.0" insulation wrapping or any other such stand-off applications. Finished with a white Chromate plating process which provides durable corrosion resistance. Auto Planting ASTM B-633 Type II (white) class FE/ZN8 or SC2 Thickness of 0.0003.
b. Handle and Thumb Trigger: Polyamide 66 (PA66), Flame Retardant, Glass Reinforced, "Zytel," by Dupont.
c. Compression Spring: Stainless Steel Type 302-OD 0.25 wire 0.026 free length of 7/8" (0.875").
d. Retaining Spring: Ext. Self-Lock TX-75ST-ZF Carbon Steel SAE 1074 with Zink Bright Plating. C-Scale Rockwell Hardness 47 to 51.

C. Steel, Manual Volume Dampers:

1. Manufacturers:

a. Air Balance Inc.; a division of Mestek, Inc.
b. American Warming and Ventilating; a division of Mestek, Inc.
c. Elgen Manufacturing.

d. Greenheck Fan Corporation.
e. GSI – A DMI Company – GreenSeam Industries
f. McGill AirFlow LLC.
g. Nailor Industries.
h. PCI Industries - Pottorff
i. Ruskin Company.

2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:

a. Hat-shaped, 0.094-inch thick galvanized or 0.05-inch stainless-steel, match duct material.
b. Mitered and welded corners.
c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

a. Multiple or single blade.
b. Opposed-blade design.
c. Stiffen damper blades for stability.
d. Galvanized or stainless-steel channels, match duct material.

6. Blade Axles: Galvanized steel or stainless steel. Dampers over 12" width/diameter shall include continuous axles. Dampers 12" and less may have non-continuous axles. Comply with SMACNA HVAC Duct Construction Standards Metal and Flexible – Third Edition Figure 7-4.

7. Bearings:

a. Molded synthetic. Provide bearing at both duct wall penetrations.

8. Tie Bars and Brackets: Galvanized steel.

D. Damper Hardware:

1. Zinc-plated, die-cast manual quadrant kit with dial and handle made of zinc plated steel, and a hexagon lock nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform or stand-off for insulated duct mounting.

2.4 BACKDRAFT DAMPERS

A. Manufacturers:

1. Cesco Products; a division of Mestek, Inc.
2. Duro Dyne Corporation.
3. Greenheck Fan Corporation. WD Series is Basis of Design.
4. PCI Industries - Pottorff
5. Ruskin Company.
6. SEMCO Incorporated.

7. Vent Products Company, Inc.

B. Description: Gravity or air pressure difference operated, spring assisted, damper allowing air flow in one direction only.

C. Maximum Air Velocity: 2500 FPM.

D. Start Open Pressure: 0.05" WC

E. Full Open Pressure: 0.10" WC.

F. Maximum Pressure Loss at Maximum Air Velocity: 0.8" WC

G. Maximum Back Pressure: 2.0" WC

H. Frame: 0.052-inch- thick, galvanized sheet steel with welded corners and mounting flange.

I. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch width, 0.025-inch-thick, roll-formed aluminum with sealed edges.

J. Blade Action: Parallel.

K. Blade Seals: Extruded vinyl, mechanically locked

L. Blade Axles:

1. Material: Galvanized steel
2. Diameter: 0.20 inch

M. Tie Bars and Brackets: Galvanized steel

N. Return Spring: Adjustable tension.

O. Bearings: Steel ball or synthetic pivot bushings.

P. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Chain pulls.
5. Screen Mounting: Front mounted in sleeve.

    a. Sleeve Thickness: 20-gage minimum.
    b. Sleeve Length: 6 inches minimum.

6. Screen Mounting: Rear mounted.
7. Screen Material: Galvanized steel
8. Screen Type: Bird
9. 90-degree stops.

2.5 FLANGE CONNECTORS

A. Available Manufacturers:

1. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Hart & Cooley, Inc.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Match connecting ductwork.

D. Gauge: 18, 20, or 24 as recommended by manufacturer or match connecting ductwork.

2.6 MANUFACTURED TURNING VANES

A. Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

B. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

C. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.7 FLEXIBLE CONNECTORS

A. Do not use on smoke control/management fans. Install on all other fans and fan equipped units even when provided with internal isolation.

B. Available Manufacturers:

1. Ductmate Industries, Inc.
2. Duro Dyne Corporation.
3. Ventfabrics, Inc.
4. Hart & Cooley, Inc.

C. Materials: Flame-retardant or noncombustible fabrics.

D. Coatings and Adhesives: Comply with UL 181, Class 1.

E. Connector: Factory fabricated with a fabric strip 3½ to 4½ inches wide attached to 2 strips of 2½ to 4½ inches wide, 23 to 25 gauge "0.0269 to .0209 inch thick" galvanized sheet steel, stainless sheet steel, or aluminum sheets. Provide metal compatible with connected ducts.

F. Indoor System, Flexible Connector Fabric: Glass fabric double-coated with neoprene.

1. Minimum Weight: 26 oz/sq. yd.
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

G. 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.

H. Thrust Limiters:

1. Field fabricated cable restraints on equipment producing greater than 4.0" WC of positive pressure.
2. Field fabricated cable restraints as detailed. If not detailed; Provide restraint consisting of a 1/16 inch diameter vinyl coated steel cable at 24" maximum on center, attached to flange bolts on each side of flexible connector. Cable length shall be such that, when in tension, ½" of movement in the flexible connection is preserved. If flanges are not used, contractor may provide steel, stainless steel, or aluminum angles for attaching cables. Match duct material. Cables shall attach to screw or fastener holding angle to duct and shall be routed through a 3/16" diameter hole in the bracket offset approximately 1" from duct.
3. Direction of connector movement: Parallel with airflow, perpendicular to connector.

2.8 FLEXIBLE AIR DUCTS

A. Manufacturers:

1. Flexmaster U.S.A., Inc. (Basis of design, Provide Type 1M)
2. Thermaflex
3. Hart & Cooley, Inc.

B. Provide bead on connecting duct for sizes greater than 12" in diameter.

C. Maximum Length: 6'-0" unless noted otherwise.

D. Insulated, Flexible Duct: UL 181, Class 1 air duct with vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.

1. Pressure Rating: 10-inch WC positive and 1.0-inch WC negative.
2. Maximum Air Velocity: 5000 fpm.
3. Vapor Barrier Permeance: 0.05 perm
4. Temperature Range: Minus 10 to plus 160 deg F.
5. Insulation R-value: 6.0

E. Flexible Duct Connection Accessories:

1. Low pressure (Not up stream of terminal units):
   a. Clamps: Nylon strap in sizes 3 through 20", to suit duct size.
   b. Sheet metal screws: No
   c. Liquid adhesive: No
   d. Tape: Yes

2.9 ACCESSORY HARDWARE

A. Temporary Test Holes: Drilled in duct as required.

B. Permanent Test Holes: Cast iron, or cast aluminum, to suit adjacent material, including cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit wall + insulation thickness.

C. Adhesives: High strength, quick setting, waterproof, and resistant to grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

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. Radius Forming Braces:

1. Connect flexible ducts to diffusers using a radius forming brace or rigid elbow. If using radius forming brace, deduct four duct diameters from the indicated maximum flexible duct length.

D. Volume Dampers:

1. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Locate at least two duct diameters from fittings and as far as possible from air outlets.
2. 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. Set dampers to fully open position before testing, adjusting, and balancing.
   a. Install steel volume dampers in steel ducts.
   b. Install aluminum volume dampers in aluminum and stainless steel ducts.

E. Install motorized control dampers where indicated.

F. Install backdraft dampers at inlet of exhaust fans, exhaust ducts as close as possible to louver inlets, and where indicated.

G. Install fire[dampers where indicated according to UL listing and manufacturer's written instructions.

H. Connect ducts to duct silencers with flexible duct connectors.

I. Turning Vanes:

1. Install turning vanes in all duct elbows larger than 12" in height or width.
2. Exceptions:
   a. Where prohibited by the applicable code, laws, ordinances or local requirements.
   b. Where specifically eliminated by Contract.

J. Flexible Connectors

1. Install flexible connectors to connect ducts to equipment- except smoke control/management equipment.
2. Where required, install thrust limiters at all flexible connectors consisting of a 1/16-inch diameter vinyl coated steel cable at 24" maximum on center, attached to flange bolts on each side of flexible connector. Cable length shall be such that, when in tension, 1/2" of movement in the flexible connection is preserved. If flanges are not used, provide steel, stainless steel, or aluminum angles for attaching cables. Match angle material to duct material. Cables shall attach to screw or fastener holding angle and shall be routed through a 3/16" diameter hole in the angle offset approximately 1" from duct.

K. Connect flexible ducts to metal ducts as follows:

1. Low pressure (Not upstream of terminal units):
   a. Clamps: Install in accordance with manufacturer's recommendations.
   b. Tape: Install in accordance with manufacturer's recommendations.
   c. Cable Ties (18 lb. strength): Install in accordance with manufacturer's recommendations.

L. Flexible Ducts

1. Install flexible duct fully extended with no more than 1/2" compression or sag. Do not provide excess length for future relocation of components. Bends shall equal or exceed one duct diameter bend radius based on the inside duct diameter (no sharp corners or kinks). Tape and mastic for sealing flexible duct to metal fittings shall be listed and labeled to UL Standard 181B. Hanging straps, if used, shall include a saddle to avoid crimping the duct. For ducts 12 inches and smaller in diameter, provide a 3" wide saddle. For ducts larger than 12 inches in diameter, provide a 5" wide saddle.
2. Connect supply ceiling diffusers and return grilles to low pressure supply and/or return ductwork where indicated on drawings with [**five**] feet maximum length of flexible duct. Provide a radius forming elbow to support flexible duct at diffuser connection unless noted otherwise. Flexible duct not permitted on exhaust systems.

3.2 TESTING AND BALANCING

A. Install permanent test holes at fan inlets and outlets within 6 inches of fan, where indicated, and where necessary for testing and balancing. Test holes not required at outlet of roof-mounted fans.

B. Install temporary test hole plugs in temporary test holes. Repair insulation at temporary test holes.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement without interference.
2. Inspect access doors. Verify that door can be opened and closed. Verify fire damper, and combination fire and smoke damper fusible links can be reset and changed. Verify fire damper, and combination fire and smoke damper doors open in the direction of air pressure (out on supply ducts and in on return and exhaust ducts).
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement, verify non-interference, and verify that the proper heat-response device is installed.
4. Inspect elbows for turning vanes. Verify they are installed where required.
5. Inspect turning vanes using access doors for proper and secure installation.
6. Operate remote damper operators prior to ceiling installation to verify full range of movement of operator and damper. Verify no interference with damper movement.

END OF SECTION 233300

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

A. Product Data: Provide manufacturer's technical data for each ventilator including rated capacities, dimensions, required clearances, operating characteristics, mounting requirements, and furnished specialties and accessories. Provide power and control wiring diagrams. Also include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs with required slope and dimensions. Indicate shimming if required.
7. Fan speed controllers.

B. Operation and Maintenance Data: For ventilators to include in emergency, operation, and maintenance manuals.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for grease (kitchen) hood exhaust shall also comply with UL 762.

1.4 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.5 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set for each belt-driven fan. Mark belt set with fan ID and turn over to owner's representative.

PART 2 - PRODUCTS

2.1 INLINE CENTRIFUGAL FANS

A. Manufacturers:

1. Acme Engineering & Manufacturing Corporation.
2. Greenheck Fan Corporation.
3. Loren Cook Company.
4. Twin City Fan & Blower.

B. Housing: Manufacturer's standard steel, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

C. Direct-Drive Units (where indicated in Fan Schedule): Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

D. Electrically-Commutated Motor (where direct drive fans indicated):

1. Motor enclosure: Open type.
2. Motor shall be DC electronic commutation type motor (ECM).
3. Motor shall be permanently lubricated, heavy duty ball bearing type to match with the fan load and prewired to the specific voltage and phase.
4. Internal motor circuitry to convert AC power supplied to fan to DC power to operate motor.
5. Motor shall be speed controllable down to 20% of full speed. Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

E. Belt-Driven Units (where indicated in Fan Schedule): Motor mounted on adjustable base, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

F. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

G. Provide accessories:

1. Companion Flanges: For inlet and outlet duct connections.
2. Motorized Backdraft Damper(s): Provide damper(s) with electric actuator(s) wired to close when fan stops and open with fan is on. Actuator voltage shall match fan motor voltage. Where matching actuator and fan voltage is not possible, fan manufacturer shall

provide transformer to produce compatible voltage to actuator. Wiring of fan and backdraft damper actuator(s) shall be by Division 26.

3. When fan motor is not electronically commutated (EC), provide integrated speed controller for final balancing.

2.2 MOTORS

A. Refer to section "Common Motor Requirements for HVAC Equipment."

B. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.

1. Motor Sizes: Size shall be as indicated. If not indicated, provide motor large enough to drive load and avoid operation in service factor range above 1.0.
2. Controls: Provide controllers, electrical devices, and wiring to comply with requirements specified in Division 26 Sections.

C. Enclosure Type: Totally enclosed, fan cooled.

2.3 FASTENERS

A. Security: Button head 1/4" diameter by 1-1/4" long (minimum size) sheet metal screws with torx head and center reject pin.

B. Refer to paragraph "SUBMITTALS"

2.4 SOURCE QUALITY CONTROL

A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install HVAC Power Ventilators level and plumb.

B. Secure roof-mounted fans to roof curbs with security fasteners. Refer to Section "Roof Accessories" for other installation requirements for roof curbs.

C. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

D. Support suspended units from structure using threaded steel rods and elastomeric hangers having a static deflection of 0.5 inches.

E. Install units with clearances for service and maintenance.

F. Label units.

3.2 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Verify that Shipping blocking and bracing are removed.
2. Verify that unit is secure and connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. For belt drive units 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 belts, adjust belt tension, and install belt guards.
5. Adjust damper linkages & operators for proper damper operation.
6. Verify lubrication for bearings and other moving parts.
7. Verify that manual and automatic volume control, fire, smoke, and fire/smoke dampers in connected ductwork systems are in a fully open position.
8. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm.
9. Measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

3.3 TESTING, ADJUSTING, BALANCING, AND LUBRICATION

A. Adjust damper linkages for proper damper operation.

B. Comply with requirements in Section "Testing, Adjusting, and Balancing for HVAC".

C. Replace fan and motor pulleys to achieve design airflow.

1. Disable automatic temperature-control operators, energize motor and adjust fan to required rpm.
2. Measure and record RPM.
3. Measure and record motor voltage and amperage.

D. Re-lubricate bearings.

END OF SECTION 233423

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, mounting details, and performance data including throw, drop, static pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.1 DIFFUSERS, GRILLES, AND REGISTERS

A. Manufacturers:

1. Anemostat.
2. Carnes.
3. Krueger.
4. MetalAire, Inc.
5. Nailor Industries.
6. Price Industries.
7. Titus.
8. Tuttle & Bailey.

B. General:

1. All trim pieces shall be mechanically fastened. Friction fit trim rings/frames shall not be provided or shall be mechanically fastened in the field. Fasteners shall not be visible.
2. Finish:
    a. Powder-coated or baked enamel, white, unless noted otherwise.
    b. For sidewall-mounted inlets and outlets, provide finish suitable for field painting where indicated (color shall be selected by Architect) or provide anodized clear finish where indicated.

3. Filter Grille Mounting Frame: Shall accept a 2" deep MERV 8 (30%) pleated media filter. Refer to Section "Particulate Air Filtration" for filter requirements. Provide two sets of filters for each filter grille.
4. Mounting: As indicated in schedule or match condition indicated.

C. Linear Slot Diffuser Plenums

1. Linear slot diffuser plenums shall be fully insulated. Provide one of the following:
   a. Factory-installed, internal fiberglass insulation on sides and end caps.
   b. Factory-installed, external aluminum foil-backed insulation.
   c. Field-installed external insulation on plenums not factory-insulated. Refer to Section 230700 HVAC Insulation.

D. Ceiling Diffusers

1. Ceiling diffuser backpans shall be externally insulated. Provide one of the following:
   a. Factory-installed with foil/scrim vapor barrier insulation with a minimum R-value of 6.
   b. Field-installed external insulation on backpans not factory-insulated. Refer to Section 230700 HVAC Insulation.
2. For diffusers connected to flexible duct, provide one of the following:
   a. Diffuser manufacturer's optional extended depth, beaded inlet neck.
   b. Field-provided 4" long galvanized steel duct collar with diameter matching diffuser inlet. Attach to diffuser inlet with a minimum of four sheet metal screws evenly distributed around collar.

2.2 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for installation tolerances and other conditions affecting performance.

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

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Install diffusers, registers, and grilles flush with ceiling unless otherwise indicated.

C. 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. Install in locations indicated as much as practical. For units installed in lay-in ceiling panels, center units in both directions in panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

D. Linear Slot Diffuser Installation: Adjust each slot diffuser so half the slots throw horizontally along the ceiling in each direction unless indicated otherwise. For linear slot diffusers above windows at building perimeter, one half of the total slots at each diffuser shall be adjusted to throw air vertically downward to wash window, and the other half of the slots shall be adjusted to throw air horizontally across ceiling unless indicated otherwise.

E. Diffusers, registers and grilles shall be supported independently of the ceiling system and shall not be supported from conduit, piping or unrelated ductwork.

F. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 233723 - HVAC GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Spun Aluminum Intake Gravity Ventilators.

1.3 ACTION SUBMITTALS

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

B. Shop Drawings: For gravity ventilators. Include plans, elevations, sections, details, ventilator attachments to curbs, and curb attachments to roof structure.

1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.

1.4 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T-52.

B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.

C. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 zinc coating, mill phosphatized.

2.2 FABRICATION, GENERAL

A. Factory or shop fabricate gravity ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.

D. Fabricate supports, anchorages, and accessories required for complete assembly.

2.3 LOUVERED INTAKE AND RELIEF GRAVITY VENTILATORS

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

1. Acme Engineering & Mfg. Corporation.
2. Greenheck Fan Corporation
3. Loren Cook Company.
4. PennBarry.

B. Construction: mitered corners, all aluminum construction, removable hoods, and weather-resistant blades.

C. Roof Curbs: Aluminum sheet; with 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 fit roof opening and ventilator base.

1. Configuration: Self-flashing without a cant strip, with mounting flange.
2. Overall Height: 12 inches above roof insulation.
3. Match roof slope. Top of curb shall be level and edge shall be flush with other edges on all sides.

D. Bird Screening: Galvanized-steel, 1/2-inch- square mesh, 0.041-inch wire.

E. Aluminum Finish:

1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.

F. Accessories:

1. Dampers:

a. Location: Gravity ventilator neck.
b. Control: Motorized. Interlock with associated units.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install gravity ventilators level, plumb, coordinate pitched roof installation.

B. Install gravity ventilators with clearances for service and maintenance.

C. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Section 079200 "Joint Sealants" for sealants applied during installation.

D. Label gravity ventilators according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

END OF SECTION 233723

SECTION 234100 - PARTICULATE AIR FILTRATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

A. Construction Filter: A filter maintained during construction to protect ductwork from construction dust, dirt, and debris. Construction filters shall be removed temporarily during balancing and permanently after the building is occupied.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated include dimensions, required operating clearances, required access clearances, and weights.

B. Operating Characteristics: For each type of product indicated provide rated flow capacity, initial and final pressure drop at rated flow capacity.

C. Efficiency: For each type of product indicated efficiency/MERV rating and test method.

D. Fire Classification: For each type of product indicated provide the fire classification.

E. Specialties and Accessories: For each type of product indicated provide furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of filter and rack to include in emergency, operation, and maintenance manuals.

B. Replace all permanent filters with new filters of types specified.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. 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.

C. Comply with NFPA 90A and NFPA 90B.

1.6 COORDINATION

A. Coordinate sizes and locations:
1. Within air handling units.
2. On open return ducts during construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:

1. Air Filters, and Filter-Holding Systems:

a. 3M.
b. Airguard.
c. American Air Filter Company, Inc. Flanders.
d. Camfil USA.
e. Columbus Industries, Inc.
f. Koch Filter Corp.

2.2 GENERAL FILTERS

A. For return filter grilles, general filtration, and construction filters provide the following:

1. Media: Cotton and synthetic pleated with an average efficiency of 25-30% and an average arrestance of 90-92% in accordance with ASHRAE test standard 52.1-1992.
2. Thickness: Unless otherwise indicated thickness shall be 2".
3. Media Support Grid: Welded wire on 1" centers with 96% free area bonded to the media.
4. Filter Frame: High wet strength cardboard with diagonal support members bonded to the media on the entering side and exiting side of each pleat.
5. Holding Frame: Galvanized steel with metal grid on outlet side, polyurethane gaskets, and spring fasteners.
6. Farr 30/30 or equal.

2.3 PRE-FILTERS

A. Where pre-filters are indicated and for construction filters provide the following:

1. Media: Cotton and synthetic pleated with an average efficiency of 25-30% and an average arrestance of 90-92% in accordance with ASHRAE test standard 52.1-1992.
2. Thickness: Unless otherwise indicated thickness shall be 4".
3. Media Support Grid: Welded wire on 1" centers with 96% free area bonded to the media.
4. Filter Frame: High wet strength cardboard with diagonal support members bonded to the media on the entering side and exiting side of each pleat.
5. Holding Frame: Galvanized steel with metal grid on outlet side, polyurethane gaskets, and spring fasteners.
6. Farr 30/30 or equal.

2.4 INSTALLATION

A. Position each filter with clearance for normal service and maintenance.

B. Install filters to prevent passage of unfiltered air.

C. Do not operate fan system until filters are in place. During construction, all ductwork must be protected from dirt and debris. Remove filters used during construction and testing. Replace all filters in units with new filters of types specified.

D. Unit operation during construction:

1. Install minimum MERV 8 construction filters to protect all return ductwork from dirt and debris. Supply fan shall operate at all times.

E. Unit not operating during construction:

1. Install plastic sheet material over all supply and return openings to protect all ductwork from dirt and debris.
2. Fans shall be off.

F. Construction filter installation: Adhere all edges of filter with metal foil peel-n-stick tape having an acrylic adhesive.

2.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Check for leakage of unfiltered air while system is operating.

B. Air filter and installation will be considered defective if they do not pass.

C. Prepare a report for each filter.

2.6 TESTING AND BALANCING

A. Immediately prior to testing and balancing, install new filters of the same type that shall be permanently installed.

END OF SECTION 234100

SECTION 237413 - PACKAGED OUTDOOR CENTRAL STATION AIR HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 ABBREVIATIONS

A. ABMA American Bearing Manufacturers Association. (www.abma-dc.org)

B. ANSI American National Standards Institute. (www.ansi.org)

C. BAS Building Automation System.

D. CFM Cubic Feet per Minute.

E. DDC Direct-digital controls.

F. ECM Electrically commutated motor.

G. FPM Feet Per Minute.

H. HP Heat pump

I. RTU Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central station air handling unit. This abbreviation is used regardless of whether the unit is mounted on the roof or on an equipment pad on the ground.

J. SS Stamped Steel

K. VVT Variable-air volume and temperature.

L. VUSBC Virginia Uniform Statewide Building Code

M. W Wire

N. WG Water Gauge

1.3 DEFINITIONS

A. Archival Quality: Will last a minimum of 20 years.

B. Head end: Main temperature control computer system storing data accessible to the internet for WEB accessible systems and storing data accessible to the building system backbone for non-WEB accessible systems.

C. HP Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations.

D. Modulating: Able to electrically vary and stop in any position.

E. Outdoor air: Air outside the building or taken from outdoors and not previously circulated through the building.

F. Outdoor air measurement: Reporting of the volume of outdoor air taken into the building by RTU and reported to the building operator in CFM.

G. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations.

H. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

I. Record: Maintain in writing on original paper and maintain a copy in electronic format, file type Portable Document Format (*.PDF) is acceptable. Make paper copy available for inspection upon request by Owner, Owner's representative, Architect, or Architect's representative. Email electronic copy to requested email address when request is made by the Owner, Owner's representative, Architect, or Architect's representative. Document shall be "openable" by Owner and Architect's computer.

J. Supply-Air Fan: Fan providing supply air to conditioned space.

K. Supply air: Air entering a space from air-conditioning, heating, or ventilating equipment.

L. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

M. Two-position: Able to electrically move and stop in only two positions. Usually open or closed.

1.4 PERFORMANCE REQUIREMENTS

A. Support: RTU supports shall comply with required wind and seismic performance requirements, including analysis by a qualified professional engineer.

B. Wind-Restraint Performance shall comply with SEI/ASCE 7 for wind speed and building classification category. Provide minimum 10 lb/sq. ft. multiplied by the maximum area of the mechanical component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

C. Seismic Performance: RTUs shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. Unless otherwise indicated 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." The unit will not be required to operate after the event.

1.5 SUBMITTALS

A. Pre-submittal Meeting: A representative of the manufacturer producing equipment being provided under this section of the specifications shall attend a meeting for the purpose of coordinating with the contractor performing work under section "Building Automation System". The meeting shall be held at a location of the Contractor's choosing. The Contractor shall arrange the meeting. Submittals shall be essentially complete at the time of the meeting so detailed coordination items can be discussed.

B. Product Data: Provide manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, accessories, and mounting requirements.

C. Exterior Color: Manufacturer's standard color shall be acceptable.

D. Shop Drawings:

1. Detail equipment assemblies, include:
   a. Internal components
   b. Dimensions
   c. Weights
   d. Loads
   e. Supports
   f. Required clearances.
2. Provide method of field assembly.
3. Indicate:
   a. Components
   b. Location
   c. size of each field connection
4. Provide Wiring Diagrams for:
   a. Power
   b. Control
5. For RTU Support comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for support selection.
   a. Calculations: Calculate requirements for selecting vibration isolation, seismic restraint where required**,** and for vibration isolation.
   b. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system, curb slope, and curb dimensions.
   c. Restraint: Detail fabrication and attachment of restraints. Indicate anchorage details, quantity, diameter, and connections.

E. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are indicated and coordinated using input from installers:

1. Plan areas containing an RTU indicated at ¼" = 1'- 0" or greater on construction drawings.
2. Areas within 20 feet of section marks indicated on M2 series drawings where such section marks penetrate an RTU.
3. Structural members to which RTUs will be attached.
4. Related roof openings.
5. Related roof curbs, slope, dimensions and flashing.

F. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," Provide the following:

1. After successful completion of testing & balancing, or commissioning provide the following:
   a. Completed Inspection & Testing form.
   b. Record copy of site-specific software on DVD.
   c. Maintenance, Inspection and Testing Records including, may not be limited to, the following:
      1) How to test installed components.
      2) Frequency of testing of installed components.
      3) Frequency of inspection of installed components.
      4) Manufacturer's user training manuals.
2. Manufacturer's required maintenance related to system warranty requirements.
3. Software and Firmware Operational Documentation:
   a. Software operating and upgrade manuals.
   b. Program Software Backup: On magnetic media or compact disk, complete with data files.
   c. Device address list.
   d. Printout of software application and graphic screens.

G. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

A. ARI Compliance:

1. Comply with ARI 210/240 and ARI 340/360 for testing and rating energy efficiencies for RTUs.
2. Comply with ARI 270 for testing and rating sound performance for RTUs.

B. System safety. Comply with one of the following:

1. ASHRAE 15 for refrigeration system safety.
2. ASHRAE/IESNA 90.1-2004 applicable requirements in Section 6 - "Heating, Ventilating, and Air-Conditioning."
3. NFPA 90A and NFPA 90B.

4. UL 1995.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to provide labor and materials to remove and replace components of RTU's that fail in materials or workmanship within the following warranty period.

1. Compressors: 5 years from date of Final Acceptance.
2. Gas Furnace(s): 5 years from date of Final Acceptance.
3. Gas Furnace Heat Exchanger(s): 5 years from date of Final Acceptance.
4. VFD: 3 years from date of Final Acceptance.
5. Remainder of unit: 1 years from date of Final Acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Daikin

B. Johnson Controls

C. Trane

D. Greenheck

2.2 GENERAL

A. Rooftop Unit Rooftop Unit: Provide a packaged rooftop unit (packaged electric cool/gas heat), designed for single zone constant air volume airflow, variable speed or digital scroll compressors on lead circuit with DX cooling coil, gas heat exchanger, hot gas reheat, direct drive plenum supply fan, double wall casing, outdoor air and return air dampers, relief damper, exhaust fan, and factory installed controls as required by this specification. Gas furnace to have 4:1 turndown or greater.

2.3 CASINGS

1. General:

a. Fabrication Requirements Rooftop Units: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
b. Fabrication Requirements for all other units: Formed and reinforced single-wall panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
c. Exterior Material: Manufacturer's standard thickness galvanized steel with factory-painted finish, exterior color shall be manufacturer's standards, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
d. Interior Material for units: Galvanized steel with no finish or factory standard finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections.

2. Fan Discharge Plenum Interior Material: Galvanized steel with no finish or factory standard finish.

3. Insulation and Adhesive:

a. Comply with NFPA 90A or NFPA 90B.
b. Materials: ASTM C 1071, Type I.
c. Thickness: 2".
d. Materials in contact with air stream shall have air-stream surface coated with an erosion- and temperature-resistant coating or they shall be faced with a plain or coated fibrous mat or fabric.
e. Liner Adhesive: Comply with ASTM C 916, Type I.

B. Condensate Drain Pans:

1. Formed sections of stainless-steel sheet, a minimum of 2 inches deep, and complying with ASHRAE 62.1-2004.

2. Construction: Provide foam insulation on back. Double wall, foam insulated, moisture tight drain pans are acceptable.
3. Drain Connection(s): Threaded nipple with pan sloped in two directions to drain.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004 and UL 181.

2.4 ECONOMIZER SECTION

A. Unit shall be provided with an outdoor air economizer section. The economizer section shall include outdoor, and exhaust air dampers. The economizer operation shall be fully integral to the mechanical cooling and allow up to 100% of mechanical cooling if needed to maintain the cooling discharge air temperature. The outdoor air hood shall be factory installed and constructed from galvanized steel finished with the same durable paint finish as the main unit. The hood shall include moisture eliminator filters to drain water away from the entering air stream. The outside and return air dampers shall be sized to handle 100% of the supply air volume. The dampers shall be opposed blade design. Damper blades shall be as specified

hereafter. A bird screen shall be provided to prevent infiltration of rain and foreign materials. Control of the dampers shall be by factory installed actuators. Damper actuator shall be of the modulating, spring return type. A comparative enthalpy control shall be provided to sense and compare enthalpy in both the outdoor and return air streams to determine if outdoor air is suitable for "free" cooling. If outdoor air is suitable for "free" cooling, the outdoor air dampers shall modulate in response to the unit's temperature control system.

2.5 FANS

A. Fans except Condenser Fan(s): Refer to schedule for blade and fan configuration. Provide with permanently lubricated, motor installed on an adjustable fan base resiliently mounted in the casing. Provide aluminum wheel and steel scroll.

B. Fan Shaft Bearings:

1. Prelubricated and Sealed, Ball Bearings: Self-aligning, pillow-block type with a rated life of 120,000 hours according to ANSI/ABMA 9

Or

2. Grease-Lubricated, Tapered-Roller Bearings: Self-aligning, pillow-block type with double-locking collars and 2-piece, cast-iron housing with grease lines extended to outside unit and a rated life of 120,000 hours according to ANSI/ABMA 11.

C. Fan Sound-Power Levels:
1. Fans, except condenser fans, shall meet or create lower sound power levels than those indicated.
2. Fans, except condenser fans, shall comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.

D. Fan Performance Rating: Except condenser fans factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."

E. Condenser Fan(s): Propeller mounted on shaft of permanently lubricated motor.

F. Fan Motor(s): Refer to section "Common Motor Requirements for HVAC Equipment."

2.6 COILS

A. Indoor Air Refrigerant Coil:

1. Aluminum fins, seamless copper tube with minimum 0.020" wall thickness, and equalizing vertical distributor.
2. Distribution: Interlaced.
3. Circuits: Minimum of one per compressor.
4. Casing: Galvanized steel.

5. Split: As indicated. If not indicated none required.

B. Outdoor Air Refrigerant Coil:

1. Aluminum fins, seamless copper tube with minimum 0.020" wall thickness, and equalizing vertical distributor.
2. Distribution: Interlaced.
3. Circuits: Manufacturer's standard.
4. Casing: Galvanized steel.
5. Split: As indicated. If not indicated Manufacturer's standard.
6. Provide baked phenolic or cathodic epoxy coating.

C. Hot Gas Reheat Coil:

1. Aluminum fins, seamless copper tube with minimum 0.020" wall thickness, and equalizing vertical distributor.
2. Distribution: Manufacturer's standard.
3. Circuits: Manufacturer's standard.
4. Casing: Galvanized steel.
5. Split: As indicated. If not indicated Manufacturer's standard.

2.7 COIL SECTION

A. Fabricate coil section to allow removal and replacement of coil(s) for maintenance and to allow in-place access for service and maintenance of coil(s).

B. Coils shall not act as a structural component of the unit.

2.8 REFRIGERANT CIRCUIT COMPONENTS

A. Provide gauge ports with Schrader valves for measuring suction and hot gas pressure.

B. Provide for operation of the unit for heating down to 0° F.

C. Provide for operation of the unit for cooling down to 35° F.

D. Compressor: Hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.

E. Refrigeration Specialties:

1. Refrigerant: R-410A.
2. Expansion valve with replaceable thermostatic element.
3. Refrigerant filter/dryer.
4. Manual-reset high-pressure safety switch.
5. Automatic-reset low-pressure safety switch.
6. Minimum off-time relay.
7. Automatic-reset compressor motor thermal overload.

8. Brass service valves and unions installed in compressor suction and discharge lines.
9. Low-ambient kit high-pressure sensor.

F. The following is required for heat pump applications:

1. Four-way reversing valve with a replaceable magnetic coil
2. Thermostatic expansion valve bypass check valves.
3. Suction line accumulator.

G. The following is required for applications with hot gas reheat:

1. Hot-gas reheat solenoid valve with a replaceable magnetic coil.

2.9 GAS FURNACE

A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47 and NFPA 54.

1. CSA Approval: Designed and certified by and bearing label of CSA.

B. Burners: Stainless steel.

1. Fuel: As indicated.
2. Ignition: Electronically controlled electric spark or hot-surface igniter with flame sensor.

C. Heat-Exchanger: Stainless steel for units over 5 tons, aluminized steel for units 5 tons and less.

D. Drain Pan: Stainless steel.

E. Venting: Gravity or power vented.

F. Safety Controls: Manufacturer's standard in accordance with local and state code requirements.

G. Capacity Control: As scheduled or listed previously in this specification. If not scheduled or listed previously modulating or staged control shall be provided.

1. Cycle: All heat on or off as needed
2. Stage: Provide a minimum of 4 stages, 25%, 50%, 75%, and 100%. Maximum temperature rise at 25% shall be fifteen degrees Fahrenheit (15° F).
3. Modulating: Heat output shall be variable down to 20% of scheduled capacity or a maximum temperature rise of fifteen degrees Fahrenheit (15° F).

2.10 AIR FILTRATION SECTION

A. Required sections: Provide filter sections indicated. If not otherwise indicated provide MERV 8 (30% efficient) 2" thick disposable pre-filters with MERV 13 (85% efficient) 4" thick final-filters.

B. Position: Final-filter shall be downstream of pre-filter

C. Refer to Division 23, Section "Filters"

2.11 DAMPERS

A. General Requirements for Dampers: Leakage rate, according to AMCA 500, "Laboratory Methods for Testing Dampers for Rating," shall not exceed 2% of air quantity at 2000 FPM face velocity through damper and 4" WG pressure differential.

B. Minimum Outdoor Air Damper(s): Two position parallel or opposed blade galvanized steel motorized mechanically fastened to cadmium plated steel operating rods in reinforced cabinet, with bird screen and intake hood. Provide method of setting minimum outdoor air.

C. Economizer Outdoor Air Damper(s): Modulating opposed blade galvanized steel motorized mechanically fastened to cadmium plated steel operating rods in reinforced cabinet, with bird screen and intake hood. Provide method of setting economizer maximum equal to supply ai.r

D. Return Air Damper(s): Two position (modulating if mechanically interlocked with mixing damper) parallel or opposed blade galvanized steel dampers mechanically fastened to cadmium plated steel operating rod in reinforced cabinet.

E. Mixing Damper(s): Modulating parallel blade galvanized steel dampers mechanically fastened to cadmium plated steel operating rod in reinforced cabinet. Operating rods may be connected with a common linkage and interconnected so return and mixing dampers operate simultaneously. Dampers shall be positioned such that airflows collide to promote mixing.

F. Relief Air Damper(s): Parallel or opposed blade galvanized steel motorized mechanically fastened to cadmium plated steel operating rods in reinforced cabinet, with bird screen and relief hood.

G. Damper Motors:

1. Fail closed.
    a. Exceptions:
        1) Supply air damper shall fail open.
        2) Return air damper shall fail open.
2. Modulating operation unless two-position is indicated.
3. Adjustable minimum position.

2.12 ELECTRICAL POWER CONNECTION

A. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

B. Power connection shall provide uninterrupted 115V power at 22 amps, regardless of voltage supplied to unit. When power is interrupted to unit, the outlet will continue to provide power.

1. Option: separate circuit to unit provided at no additional cost.

2.13 CONTROLS

A. Basic Unit Controls:

1. The manufacturer furnishing units and the contractor installing units under this section shall refer to, among others, Section "Building Automation System", Section "Sequences of Control", and the Seven (7) series control drawings for additional information regarding control of the equipment.

2. Provide control voltage transformer:

   a. Primary Voltage: As required
   b. Secondary Voltage: As required
   c. Load: As required - 100 VA minimum

3. Unit Mounted Control Panel:

   a. Furnish under section "Building Automation System" and install under this Section.
   b. Interface control panel with BAS.
   c. Provide volatile memory backup.
   d. Provide software and firmware operational documentation including but not limited to:
      1) Software operating and upgrade manuals.
      2) Backup of Volatile Memory: On archival quality DVD or CD compliant disk, complete with data files.
      3) Device address list.
      4) Printout of software application and graphic

B. Refrigeration system control

1. The manufacturer furnishing equipment under this section shall provide all controls for the compressors and refrigeration system including but not limited to staging and safeties under this section.

C. Operation:

   a. Refer to section "Sequences of Operation"

2.14 ACCESSORIES

A. Electric Gas Burner Compartment Heater: When required by unit manufacturer provide electric heater with integral thermostat to maintain minimum 50° F in gas burner compartment.

B. Low Ambient Operation: Provide low-ambient kit for operation down to 35° F.

C. Guards:

1. Where scheduled "SS" or if not scheduled: Provide coil guards of galvanized stamped steel, painted to match casing. Guards shall be on sides of unit. Coils shall not be clearly visible from any direction.
2. Where scheduled "W": Provide coil guards of painted, galvanized-steel wire. Coils are clearly visible from nearly every direction.

2.15 ROOF CURBS

A. Provide under this section.

B. Height: 8" greater than the highest portion of adjacent roof insulation.

C. Slope: Match structure. Top of curb shall be level and each edge shall be flush with other edges on all sides.

D. Roof Deck: Remove roof deck as required for ductwork and piping installation and insulation. Where pipe chases are provided remove roof deck inside curb and inside pipe chase.

E. Wood Blocking and Shimming: Not permitted.

2.16 STAINLESS STEEL WIRE MESH:

A. Provide with roof curb.

B. Material: Type 316 stainless steel 0.061" (1.8mm) diameter wire with 0.94" (10.9mm) square openings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.

B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.

C. Examine roofs or grade for suitable conditions where RTUs will be installed.

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

3.2 INSTALLATION

A. Grade Mounted Unit:

1. Concrete Base:
   a. Anchor grade mounted equipment to concrete base.
   b. Install RTUs on concrete base using elastomeric pads.
   c. Minimum Deflection: ¼".

B. Coordination: Coordinate penetrations and flashing.

3.3 FIELD QUALITY CONTROL

A. Whether or not use of equipment is otherwise permitted, startup service, tests, and inspections must be complete prior to running unit. Failure to perform startup service, tests, and inspections prior to running equipment shall grant the owner's representative authority to have the units/equipment removed from the site at the Contractor's expense. This paragraph shall not be construed to grant the Contractor permission to use the unit(s)/equipment specified in this section of the specifications.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Record results.

C. Tests and Inspections:

1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
2. Leak Test: After installation, fill water and steam coils completely with water. Connect gauge and fill valve. Pressurize to 150 PSIG with air. Visually check for water leaks. Pressure shall hold with no visible loss for 120 minutes (2 hours). Fix leaks.
3. Charge refrigerant coils with refrigerant and connect gauges. Use light that will show refrigerant leak and visually check for leaks. Pressure shall hold with no visible loss for 120 minutes (2 hours). Fix leaks.
4. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Replace or repair faulty equipment.
5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. RTU's or components will be considered defective if unit or components do not pass tests and inspections.

E. Prepare test and inspection reports.

3.4 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 and do the following:

1. Verify that unit is secure on mountings and supporting devices and connections to piping, ducts, and electrical systems are complete.

2. Verify that proper thermal overload protection is installed in motors, controllers, and switches.
3. Disconnect fan drive system. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operation. Reconnect fan drive system, align and adjust belts to proper tension.
4. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
5. Verify that dampers fully open and close.
6. Inspect dampers for proper stroke.
7. Inspect damper blades and seals for visible defects.
8. Inspect coil fins. Comb damaged coil fins for parallel orientation.
9. Verify that proper thermal overload protection is installed for electric coils.
10. Install new filters.
11. If not direct drive place new belts on coat hook attached with ¼" long stainless steel sheet metal screws inside unit adjacent to existing belts where no damage will occur. Including but not limited to fans, energy recovery wheels, and enthalpy wheels.
12. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.
13. Verify that smoke dampers in connected duct system fully close when unit is deactivated.
14. Inspect for visible damage to unit casing.
15. If included in unit inspect furnace combustion chamber for visible damage.
16. Inspect coils, and fans for visible damage.
17. Inspect internal casing for visible damage.
18. Verify that labels are clearly visible.
19. Verify that clearances have been provided for servicing.
20. Verify that controls are connected and operable.
21. Clean condenser coil and inspect for construction debris.
22. If included in unit, clean furnace flue and inspect for construction debris.
23. If furnace is included in unit purge and connect gas line.
24. Remove packing from vibration isolators.
25. Inspect fan wheel for operation without vibration and binding.
26. Start unit according to manufacturer's written instructions.
    a. Start cooling system.
    b. Do not operate below recommended ambient temperature.
    c. Complete startup sheets and attach 1 paper, and one "universally readable" electronic copy on USB flash drive, with startup report. Maintain a copy in electronic format, file type Portable Document Format (*.TXT, *.DOC, *.RTF, & *.PDF) file formats are acceptable. The file format must be one of those listed or the Owner and Architect must own a computer and software capable of reading the electronic file.
27. Inspect and record performance of interlocks and protective devices.
28. Verify sequence of operation.
29. Operate unit for an initial period as recommended or required by manufacturer.
30. For unit(s)/Equipment equipped with a furnace perform the following operations for minimum and maximum firing. Adjust burner for peak efficiency within operating range.
    a. Measure and record manifold gas pressure.
    b. Confirm proper operation of power vents.
    c. Measure and record combustion air temperature at inlet to combustion chamber.
    d. Measure and record flue gas temperature at furnace discharge.

e. Perform flue gas analysis. Measure and record flue gas carbon dioxide and oxygen concentration.
f. Measure and record return air temperature and volume, and supply air temperature and volume when burner is at maximum firing rate. Calculate and record heat input from the burner to the supply air.

31. Calibrate sensors including thermostats.
32. Adjust and inspect high-temperature limits.
33. With unit operating start cooling system, measure, and record the following when the ambient temperature is a minimum of 85° F:
    a. Coil leaving air, dry and wet bulb temperatures.
    b. Coil entering air, dry and wet bulb temperatures.
    c. Return air, dry and wet bulb temperatures.
    d. Outdoor air, dry and wet bulb temperatures.
    e. Outdoor air (condenser) coil, discharge air, dry bulb temperature.
34. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
    a. Supply air volume.
    b. Return air volume.
    c. Relief/exhaust air volume.
    d. Record relief/exhaust airflow station reading in CFM from BAS head end.
    e. Outdoor air intake volume.
    f. Record outdoor air intake airflow station reading in CFM from BAS head end.
35. Simulate maximum cooling demand by utilizing 100% outdoor air and lowering discharge air temperature. Record the discharge air temperature and outdoor air volume used for the simulation. During simulation operation inspect, measure, and record the following:
    a. Compressor refrigerant suction and hot gas pressures.
    b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.

3.5 CLEANING AND ADJUSTING

A. Occupancy Adjustments: Within 12 months of the date of Final Acceptance, provide up to two (2) on site visits, during normal or other than normal occupancy hours as requested by owner, to assist in adjusting system.

B. After completing testing, adjusting, and balancing clean RTU's internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, filters.

3.6 DEMONSTRATION

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

END OF SECTION 237413

SECTION 238219 - FAN COIL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

A. This Section includes fan-coil units and accessories.

1.3 DEFINITIONS

A. BAS: Building automation system.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For fan-coil units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Closeout Procedures," include the following:

1. Maintenance schedules and repair part lists for motors, coils, integral controls, and filters.

E. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.6 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.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan-Coil-Unit Filters: Furnish one spare filter for each unit.
2. Fan Belts: Furnish one spare fan belt for each unit installed.

PART 2 - PRODUCTS

2.1 DUCTED BLOWER COIL UNITS

A. Available Manufacturers:

1. Daikin.
2. Trane.
3. Johnson Controls.

B. Description: Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995.

C. Coil Section Insulation: 1-inch thick foil-faced glass fiber complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.

1. Fire-Hazard Classification: 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.
2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

D. Drain Pans: Stainless steel. Fabricate pans and drain connections to comply with ASHRAE 62.1-2004.

E. Chassis: Galvanized steel where exposed to moisture, with baked-enamel finish and removable access panels.

F. Cabinets: Steel with baked-enamel finish in manufacturer's standard paint color.

G. Filters: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
1. Pleated Cotton-Polyester Media: 90 percent arrestance and MERV 8.

H. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain.

I. Direct-Driven Fans: Double width, forward curved, centrifugal; with permanently lubricated, multispeed motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.

J. Belt-Driven Fans: Double width, forward curved, centrifugal; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in the cabinet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.

1. Motors: Comply with requirements in Division 23 Section "Motors for HVAC Equipment."

2.2 Control devices and operational sequence are specified in Division 23 Sections "Building Automation System" and "Sequence of Operations."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive fan-coil units for compliance with requirements for installation tolerances and other conditions affecting performance.

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.

3.2 INSTALLATION

A. Install units level and plumb.

B. Install units to comply with NFPA 90A.

C. Suspend units from structure with elastomeric hangers. Vibration isolators are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

D. Install new filters in each fan-coil unit within two weeks after Substantial Completion.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 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 the pressure of fan. Install cleanouts in piping at changes of direction.

B. Connect supply and return ducts to fan-coil units with flexible duct connectors specified in Division 23 Section "Air Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

3.5 DEMONSTRATION

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

END OF SECTION 238219

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.3 DEFINITIONS

A. VFC: Variable frequency controller.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

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. Cerro Wire LLC.
2. General Cable; General Cable Corporation.
3. Southwire Company.
4. Encore Wiring Corporation.

B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2.

2.2 CONNECTORS AND SPLICES

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. 3M.
2. Hubbell Power Systems, Inc.
3. ILSCO.
4. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by third party agencies shall be amongst those accredited by the SCBCC (South Carolina Building Council) and marked for intended location and application.

B. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger, except VFC cable, which shall be extra flexible stranded.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW-2, single conductors in raceway.

B. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-2-THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.

E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway.

F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.

G. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Branch Circuits Concealed in Casework: FMC conduit may be used to feed to outlet boxes fish concealed in built-in casework. Route cable supported tight in upper inside corners of casework, not in conflict with drawers or cabinet doors.

G. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

H. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

I. Whips from Junction Box Concealed in Ceilings to Lighting Fixtures:
   1. Type FMC conduit, with minimum #12AWG copper THHN/THWN and full size equipment grounding conductor. Maximum whip length 72".
   2. FMC shall be supported within 24" of fixture connection so that whip is not in contact with ceiling or grid. Securing to fixture support wires with batwings is acceptable but not to ceiling support wires.
   3. Do not connect fixture whips from fixture to fixture (daisy chain). No more than 4 whips shall be connected to any one junction box.

J. All single-phase circuits shall include a dedicated neutral (grounded) and grounding conductor, unless specifically noted otherwise.

1. The intent of this is to eliminate multiwire branch circuits and allow disconnection of one circuit without requiring disconnection of other(s) as would be required to comply with NEC 210.4(B). Per NEC 310.15(B)(b) each of these neutral (grounded) conductor is not considered to be load-bearing so derating is not required.

K. Contract drawings are based upon a maximum of 3 current-carrying conductors in a conduit. Contractor may rework indicated circuitry to install a maximum of (6) L-N circuits (120 or 277V) in a single conduit. There shall be no more than 2 each A, B, C phase conductors per homerun. Each shall have dedicated neutral (grounded) conductor.
1. Do not group L-L circuits in a homerun, unless specifically indicated on the drawings.
2. Where there are more than 3 current-carrying conductors in a conduit, derate conductor ampacities in accordance with NEC Table 310.15(B)(2)(a).
3. When running more than 3 ungrounded conductors in a raceway, increase size of conduits beyond those indicated in contract documents, as required to not exceed NEC Chapter 9, Table 1 conduit-fill requirements. As-built drawings shall clearly indicate which circuits are grouped in homeruns.

L. Unless otherwise indicated, minimum conductor size shall be 12 AWG.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.8 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:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Test and Inspection Reports: Prepare a written report to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes grounding and bonding systems and equipment, plus the following special applications:

1. Underground distribution grounding.
2. Ground bonding common with lightning protection system.
3. Foundation steel electrodes.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

A. As-Built Data: Plans showing dimensioned as-built 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.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Instructions for periodic testing and inspection of grounding features at test wells based on NETA MTS.

1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
2) Include recommended testing intervals.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by third party agencies shall be amongst those accredited by the SCBCC (South Carolina Building Council) and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Burndy; Part of Hubbell Electrical Systems.
2. ERICO International Corporation.
3. Galvan Industries, Inc.; Electrical Products Division, LLC.
4. ILSCO.
5. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.

2.2 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by third party agencies shall be amongst those accredited by the SCBCC (South Carolina Building Council) and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.

2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

A. Listed and labeled by third party agencies shall be amongst those accredited by the SCBCC (South Carolina Building Council) for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.

1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches long.
2. Backfill Material: Electrode manufacturer's recommended material.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.

1. Bury at least 24 inches below grade.
2. Ductbank Grounding Conductor: Bury 12 inches above ductbank when indicated as part of duct-bank installation.

C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

E. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

3.4 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

G. 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.

H. Metallic Fences: Comply with requirements of IEEE C2.

1. Grounding Conductor: Bare copper, not less than No. 8 AWG.
2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.5 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

D. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

F. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

G. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet 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 inches from building's foundation.

I. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.

1. If concrete foundation is less than 20 feet 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.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

C. 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. 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.

D. Grounding system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
5. Substations and Pad-Mounted Equipment: 5 ohms.
6. Manhole Grounds: 10 ohms.

G. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.
2. Nonmetallic slotted support systems.

1.6 QUALITY ASSURANCE

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

B. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Cooper B-Line, Inc.; a division of Cooper Industries.
b. ERICO International Corporation.
c. Thomas & Betts Corporation.
d. Unistrut; an Atkore International company.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Channel Dimensions: Selected for applicable load criteria.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- diameter holes at a maximum of 8 inches o.c., in at least 1 surface. These are to be used only where specifically indicated on the drawings.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. Fabco Plastics Wholesale Limited.

2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
4. Rated Strength: Selected to suit applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1) Cooper B-Line, Inc.; a division of Cooper Industries.
2) Hilti, Inc.
3) MKT Fastening, LLC.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slottedsupport 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.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

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. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
6. To Light Steel: Sheet metal screws.
7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Division 9 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 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Surface raceways.
5. Boxes, enclosures, and cabinets.
6. Handholes and boxes for exterior underground cabling.

B. Part 2 of this section includes material requirements for all raceways and boxes that may or may not be used on the project. Part 3 of this Section defines where a given type of product shall be or is permitted to be utilized.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid steel conduit.

C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.5 INFORMATIONAL SUBMITTALS

A. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, 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. Allied Tube & Conduit.
2. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
3. Robroy Industries.
4. Thomas & Betts Corporation.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by third party agencies shall be amongst those accredited by the SCBCC (South Carolina Building Council), and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. IMC: Comply with ANSI C80.6 and UL 1242.

E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

F. EMT: Comply with ANSI C80.3 and UL 797.

G. FMC: Comply with UL 1; zinc-coated steel.

H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Fittings for EMT:

a. Material: Steel.
b. Type: Compression Fitting

2. 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.
3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

J. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. AFC Cable Systems, Inc.
2. Electri-Flex Company.
3. RACO; Hubbell.
4. Thomas & Betts Corporation.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by third party agencies shall be amongst those accredited by the SCBCC (South Carolina Building Council) and marked for intended location and application.

C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

D. LFNC: Comply with UL 1660.

E. Rigid HDPE: Comply with UL 651A.

F. RTRC: Comply with UL 1684A and NEMA TC 14.

G. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

H. Fittings for LFNC: Comply with UL 514B.

I. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

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, Inc.; a division of Cooper Industries.
2. Hoffman; a brand of Pentair Equipment Protection.
3. Square D.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, 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.

2.4 SURFACE RACEWAYS

Insert requirements for finish-coat paint color, if applicable, in "Surface Metal Raceways" Paragraph below. See painting Sections for optional field-finish coats.

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by third party agencies shall be amongst those accredited by the SCBCC (South Carolina Building Council), and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. MonoSystems, Inc.
b. Panduit Corp.
c. Wiremold / Legrand.

2.5 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. EGS/Appleton Electric.
2. Erickson Electrical Equipment Company.
3. Hoffman; a brand of Pentair Equipment Protection.
4. Hubbell Incorporated.
5. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
6. RACO; Hubbell.

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. 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 third party agencies shall be amongst those accredited by the SCBCC (South Carolina Building Council), and marked for intended location and application.

F. 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.

G. 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.

H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

K. Device Box Dimensions: 4 inches by 2-1/8 inches by 2-1/8 inches deep.

L. Gangable boxes are allowed.

M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Fiberglass.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

N. Cabinets:

1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.6 FLOOR BOXES AND SERVICE FITTINGS

A. Basis of Design: Wiremold, RFB4 Series Floor Boxes.

1. Floor boxes mounted on first floor grade shall be manufactured from cast-iron and be approved for use on grade and above grade floors. The box shall be 14 1/2" L x 11 7/8" W x 3 7/16" H. There shall be four independent wiring compartments that allow capacity for up to four duplex receptacles and/or communication services. The RFB4-CI-1 Series Box shall permit tunneling from adjacent or opposite compartments. Two of the four compartments shall have a minimum wiring capacity of 27 cu in., and two compartments shall have a minimum wiring capacity of 36 cu in.. The box shall provide the following number of conduit hubs: four 1" and four 1 1/4". The box shall be fully adjustable, providing a maximum of 1 7/8" pre-pour adjustment, and a maximum of 3/4" after-pour adjustment. Wiremold RFB4-CI-1.

2. Activation covers shall be manufactured of die-cast aluminum or die-cast zinc, and be available in a brushed aluminum finish, plated brass finish, or a powder-coated paint finish. The activation cover shall be listed by UL to meet the applicable U.S. and Canadian safety standards for scrub water exclusion when used on tile, terrazzo, wood, and carpet covered floors. The floor box manufacturer shall provide a complete line of faceplates and bezels to facilitate mounting of UTP, STP (150 ohm), fiber optic, coaxial, and communication devices within the box.

3. Activation covers shall be available in flanged and flangeless versions of cast aluminum with aluminum, black, bronze, brass, nickel or gray finish. Covers shall be available with options for tile or carpet inserts, flush covers, or furniture feed. Flanged covers shall be 7 3/4" L x 6 9/16" W. Flangeless covers shall be 6 3/4" L x 5 9/16" W.
   a. Unless indicated otherwise, provide the following cover configurations:
      1) Power/Telecom Outlets: Brushed aluminum flanged with blank lid flush with floor and NO carpet/tile cutouts.
      2) Furniture Floor Feed: Brushed aluminum flanged with 1" trade size screw plug opening and one combination 1 1/4" and 2" trade size screw plug openings.

2.7 POKE-THRU ASSEMBLIES

A. Basis of Design: Wiremold, Evolution Series Poke-Thru Device

1. Recessed Outlet Poke-Thru Devices: 8AT Poke-Thru Devices.

2. Poke-thru devices provide an interface between power, communication and audio/visual (A/V) cabling in an above grade concrete floor and the workstation or activation location

where power, communication and/or A/V device outlets are required. These devices provide recessed device outlets that will not obstruct the floor area.

3. 8AT Poke-Thru Assembly: Poke-thru device assemblies shall consist of an insert and an activation cover. Assembly length: 16-3/4 inches (425mm).

4. Insert: Insert body shall recess the devices a minimum of 2-3/4 inches (69mm) and have a polyester based backing enamel finished interior; ivory color. Furnish with necessary channels to provide complete separation of power and communication services. Provide five (5) compartments that allow for up to five (5) duplex receptacles that can be wired as a standard receptacle or isolated ground and/or 22 communication ports and/or 16 AV devices.
   a. Body consists of an intumescent firestop material to maintain fire rating of the floor slab. Hold intumescent material securely in place in insert body. Intumescent material will not have to be adjusted to maintain fire rating of the unit and the floor slab. Provide insert with a retaining feature to hold the poke-thru device in the floor slab without additional fasteners. Poke-thru insert shall also consist of a 3/4-inch trade size conduit stub that is connected to the insert body and a 24.5 cu in (402ml) stamped steel junction box for wire splicing and connections. Stamped steel junction box shall also contain the means necessary to electrically ground the poke-thru device to the system ground.
5. Activation Cover: Manufactured of die-cast aluminum alloy; finished in powder-coated black. Provide with two (2) gaskets (one (1) for carpet and one (1) for tile) to go under the trim flange to maintain scrub water tightness. Activation cover is 9-1/4 inches (235mm) in diameter. Provide cover with spring-loaded slides to allow cables to egress out of the unit and maintain as small an egress opening as possible.

6. Communication Modules Mounting Accessories: Provide activation unit with three locations to mount communication connectors. Mount connectors using a mounting bracket capable of accepting up to 12 Category 6 insert modules or Category 6 discrete keystone connectors. Also provide unit with two (2) Category 6 discrete keystone connectors and two (2) industry standard keystones and accommodate a mechanism to permit protection of communication cabling. Fabricate mechanism from stamped steel construction. Mechanism shall accept both flexible and rigid 3/4-inch, 1-1/4-inch or two-inch trade size conduit.

2.8 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Armorcast Products Company.
    b. Carson Industries LLC.
    c. Quazite: Hubbell Power Systems, Inc.

2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with open 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.

2.9 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 accredited by the SCBCC (South Carolina Building Code Council) 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

3.1 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, direct buried.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

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: GRC.
3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:

    a. Repair Bays
    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    c. Mechanical rooms.
    d. Engine/Transmission Lab

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.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
8. Underground/In-Slab: 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 compression fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface raceways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of 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.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. All conduit to be installed on exterior masonry shall not run continuously within the wall cavity.

I. Support conduit within 12 inches of enclosures to which attached.

J. Raceways Embedded in Slabs:

1. Are not permitted, except as required for entry into recessed floor boxes.
2. Conduits run below slab on ground floor level shall be buried within the porous fill and stub-up at the required location. Transition from RNC to RGS with RGS elbow before rising above the floor. After RGS elbow, stub-up conduit shall be type indicated in Part 3.1 above.
3. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from ENT to GRC before rising above floor.

K. 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.

L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

M. 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.

N. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

O. 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.

P. 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.

Q. 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.

R. Surface Raceways:

1. Install surface raceway with a minimum 2-inchradius control at bend points.
2. 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.

S. 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.

T. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

U. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

V. 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.

W. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements and also refer to Architectural elevations. Install boxes with height measured to center of box unless otherwise indicated.

X. 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.

Y. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

Z. Locate boxes so that cover or plate will not span different building finishes.

AA. 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.

BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

CC. Set metal floor boxes level and flush with finished floor surface.

DD. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom for pipe less than 6 inches in nominal diameter.
2. 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.
3. 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.
4. Underground Warning Tape

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

D. Install handholes with bottom below frost line, below grade.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Division 07.

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content. Refer to section 079200 for requirements.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Advance Products & Systems, Inc.
b. Metraflex Company (The).
c. Proco Products, Inc.

2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel.
4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

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. HOLDRITE.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 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.

END OF SECTION 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's

wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

C. Colors for Raceways Carrying Circuits at More Than 600 V:

1. Black letters on an orange field.
2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING."

D. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

2.2 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

2.3 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-

laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.

2.4 FLOOR MARKING TAPE

A. 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

2.5 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE,.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE,.

C. Warning Tape:

1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Overall Thickness: 5 mils.
3. Foil Core Thickness: 0.35 mil.
4. Weight: 28 lb/1000 sq. ft..
5. 3-Inch Tensile According to ASTM D 882: 70 lbf, and 4600 psi.

2.6 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 10 by 14 inches.
1. Warning labels and signs shall include, but are not limited to, the following:

a. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
b. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES"
c. Arc Flash Hazard Warning: Refer to Section 260574 for requirements.

2.7 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

2.8 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.9 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch.

2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

E. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

F. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

G. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

H. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Concealed Raceways and Ductbanks, more Than 600 V, within Buildings: Tape and stencil 4-inch- wide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- high black letters on 20-inch centers. Stop stripes at legends. Apply 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.

B. Accessible Raceways and Cables within Buildings: Provide engraved laminated phenolic nameplates. Nameplates shall be securely attached to equipment using self-tapping stainless steel screws. Letters shall be 1/2" high except where resultant nameplate size exceeds equipment size. Nameplate lettering may be adjusted accordingly with approval of engineer. Nameplate material colors shall be:

1. Blue surface with white core for 120/208V equipment.
2. Black surface with white core for 277/480V equipment.
3. Bright red surface with white core for all equipment related to fire alarm system.
4. Dark red (burgundy) surface with while core for all equipment related to security.
5. Brown surface with white core for all equipment related to data systems.
6. White surface with black core for all equipment related to paging systems.

C. Pull and Junction Boxes: All pull and junction boxes shall have their covers and exterior visible surfaces painted/labeled with colors to match the surface color scheme outlined in above section "Accessible Raceways and Cables within Buildings".

D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.

a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
b. Colors for 208/120-V Circuits:

1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.
4) Grounded (Neutral): White.
5) Ground: Green.

c. Colors for 480/277-V Circuits:

1) Phase A: Brown.
2) Phase B: Orange.
3) Phase C: Yellow.
4) Grounded (Neutral): Gray.
5) Ground: Green.

d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

E. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic plastic tag holder with adhesive-backed phase tags, and a separate tag with the circuit designation.

F. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

G. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive, self-laminating polyester labels with the conductor or cable designation, origin, and destination.

H. Control-Circuit Conductor Termination Identification: For identification at terminations provide heat-shrink preprinted tubes or self-adhesive, self-laminating polyester labels with the conductor designation.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

J. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.
2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

K. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

    a. Power transfer switches.
    b. Controls with external control power connections.

M. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

N. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer and load shedding.

O. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

    a. Indoor Equipment: Adhesive film label with clear protective overlay. 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.
    b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
    c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

    a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be, laminated acrylic or melamine label.
    b. Enclosures and electrical cabinets.
    c. Access doors and panels for concealed electrical items.
    d. Switchboards.
    e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.

f. Emergency system boxes and enclosures.
g. Enclosed switches.
h. Enclosed circuit breakers.
i. Enclosed controllers.
j. Variable-speed controllers.
k. Push-button stations.
l. Power transfer equipment.
m. Contactors.
n. Remote-controlled switches, dimmer modules, and control devices.
o. Power-generating units.
p. Monitoring and control equipment.
q. UPS equipment.

END OF SECTION 260553

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Indoor occupancy sensors.
   2. Lighting contactors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

   1. Interconnection diagrams showing field-installed wiring.
   2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals indicating the following:

   1. Submittal data indicating all selected options for each piece of lighting equipment and lighting controls.
   2. Operation and maintenance manuals for each piece of lighting equipment. Required routing maintenance actions, cleaning and recommended relamping shall be clearly identified.
   3. A schedule for inspecting and recalibrating all lighting controls.
   4. A narrative of how each system is intended to operate, including recommended set points.

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY SENSORS

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 Building Automation, Inc.
2. Leviton Manufacturing Co., Inc.
3. Lithonia Lighting; Acuity Brands Lighting, Inc.
4. Lutron Electronics Co., Inc.
5. Sensor Switch, Inc.
6. Watt Stopper.

B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.

1. Listed and labeled as defined in NFPA 70, by a third-party agency that shall be amongst those accredited by the NCBCC (North Carolina Building Code Council), and marked for intended location and application.
2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
5. Mounting:

    a. Sensor: Suitable for mounting in any position on a standard outlet box.
    b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
    c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
7. Bypass Switch: Override the "on" function in case of sensor failure.
8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.

C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.

2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
3. Detection Coverage:
   a. **Standard Height Units**: In areas that have ceiling heights of 12 feet or lower, provide Watt Stopper unit DT-300 (or approved equal): Detect occupancy anywhere within a circular area up to 2000 square feet. Detectors shall be networkable to allow coverage of larger or irregularly shaped areas.
   b. **High Ceiling Units**: In areas that have ceiling/mounting height over 12 feet up to 40 foot mounting including but not limited to Gymnasium, Auditorium, Cafeteria (commons) and forum spaces, provide Watt Stopper unit HB3x0 with L4 lens, or approved equal. Detect occupancy anywhere within a circular area up to 3500 square feet. Detectors shall be networkable to allow coverage of larger or irregularly shaped areas.

2.2 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

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 Building Automation, Inc.
2. Leviton Manufacturing Co., Inc.
3. Lutron Electronics Co., Inc.
4. Sensor Switch, Inc.
5. Watt Stopper.

B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.

1. Listed and labeled as defined in NFPA 70, by a third party agency that shall be amongst those accredited by the NCBCC (North Carolina Building Code Council), and marked for intended location and application.
2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.

2.3 LIGHTING CONTACTORS

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. Allen-Bradley/Rockwell Automation.
2. ASCO Power Technologies, LP.
3. General Electric Company.
4. Square D.

B. Description: Electrically operated and mechanically held, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

C. Interface with DDC System for HVAC: Provide hardware interface to enable the DDC system for HVAC to monitor and control lighting contactors.

1. Monitoring: On-off status
2. Control: On-off operation

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 3/4 inch.

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Lighting control devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Final Acceptance, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Indoor occupancy sensors.
   2. Lighting contactors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

   1. Interconnection diagrams showing field-installed wiring.
   2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals indicating the following:

   1. Submittal data indicating all selected options for each piece of lighting equipment and lighting controls.
   2. Operation and maintenance manuals for each piece of lighting equipment. Required routing maintenance actions, cleaning and recommended relamping shall be clearly identified.
   3. A schedule for inspecting and recalibrating all lighting controls.
   4. A narrative of how each system is intended to operate, including recommended set points.

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY SENSORS

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 Building Automation, Inc.
2. Leviton Manufacturing Co., Inc.
3. Lithonia Lighting; Acuity Brands Lighting, Inc.
4. Lutron Electronics Co., Inc.
5. Sensor Switch, Inc.
6. Watt Stopper.

B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.

1. Listed and labeled as defined in NFPA 70, by a third-party agency that shall be amongst those accredited by the SCBCC (South Carolina Building Code Council), and marked for intended location and application.
2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
5. Mounting:

    a. Sensor: Suitable for mounting in any position on a standard outlet box.
    b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
    c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
7. Bypass Switch: Override the "on" function in case of sensor failure.
8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.

C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.

2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
3. Detection Coverage:
   a. **Standard Height Units**: In areas that have ceiling heights of 12 feet or lower, provide Watt Stopper unit DT-300 (or approved equal): Detect occupancy anywhere within a circular area up to 2000 square feet. Detectors shall be networkable to allow coverage of larger or irregularly shaped areas.
   b. **High Ceiling Units**: In areas that have ceiling/mounting height over 12 feet up to 40 foot mounting including but not limited to Gymnasium, Auditorium, Cafeteria (commons) and forum spaces, provide Watt Stopper unit HB3x0 with L4 lens, or approved equal. Detect occupancy anywhere within a circular area up to 3500 square feet. Detectors shall be networkable to allow coverage of larger or irregularly shaped areas.

2.2 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

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 Building Automation, Inc.
2. Leviton Manufacturing Co., Inc.
3. Lutron Electronics Co., Inc.
4. Sensor Switch, Inc.
5. Watt Stopper.

B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.

1. Listed and labeled as defined in NFPA 70, by a third party agency that shall be amongst those accredited by the SCBCC (South Carolina Building Code Council), and marked for intended location and application.
2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.

2.3 LIGHTING CONTACTORS

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. Allen-Bradley/Rockwell Automation.
2. ASCO Power Technologies, LP.
3. General Electric Company.
4. Square D.

B. Description: Electrically operated and mechanically held, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

C. Interface with DDC System for HVAC: Provide hardware interface to enable the DDC system for HVAC to monitor and control lighting contactors.

1. Monitoring: On-off status
2. Control: On-off operation

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 3/4 inch.

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Lighting control devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Final Acceptance, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes: Distribution, dry-type transformers rated 600 V and less, with capacities up to 1500 kVA.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.

B. Shop Drawings:

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Source quality-control reports.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Eaton Electrical Sector; Eaton Corporation.
2. Siemens Power Transmission & Distribution, Inc.
3. Square D; by Schneider Electric.

B. Source Limitations: Obtain each transformer type from single source from single manufacturer.

C. All panelboards, switchboards, circuit breakers, dry type transformers and disconnect switches shall be of the same manufacturer.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Transformers Rated 15 kVA and Larger: Comply with DOE 2016 energy-efficiency.

D. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.

E. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Aluminum.

F. Encapsulation: Transformers smaller than 30 kVA shall have core and coils completely resin encapsulated.

G. Shipping Restraints: Paint or otherwise color code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NFPA 70, and list and label as complying with UL 1561.

B. Cores: One leg per phase.

C. Enclosure: Ventilated.

1. NEMA 250, Type 2: Core and coil shall be encapsulated within resin compound to seal out moisture and air.
2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.

D. Transformer Enclosure Finish: Comply with NEMA 250.

1. Finish Color: Gray.

E. Taps for Transformers 3 kVA and Smaller: None.

F. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

G. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

H. Insulation Class, Smaller than 30 kVA: 185 deg C, UL-component-recognized insulation system with a maximum of 115-deg C rise above 40-deg C ambient temperature.

I. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with a maximum of 115-deg C rise above 40-deg C ambient temperature.

2.4 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.

1. Resistance measurements of all windings at the rated voltage connections and at all tap connections.
2. Ratio tests at the rated voltage connections and at all tap connections.
3. Phase relation and polarity tests at the rated voltage connections.
4. No load losses, and excitation current and rated voltage at the rated voltage connections.
5. Impedance and load losses at rated current and rated frequency at the rated voltage connections.
6. Applied and induced tensile tests.
7. Regulation and efficiency at rated load and voltage.
8. Insulation Resistance Tests:

    a. High-voltage to ground.
    b. Low-voltage to ground.
    c. High-voltage to low-voltage.

9. Temperature tests.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.

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

3.2 INSTALLATION

A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.

1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.

B. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.

C. Construct concrete bases according to Section 033000 "Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions and requirements in Section 260529 "Hangers and Supports for Electrical Systems."

1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

D. Secure transformer to concrete base according to manufacturer's written instructions.

E. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.

F. Remove shipping bolts, blocking, and wedges.

3.3 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS for dry-type, air-cooled, low-voltage transformers. Certify compliance with test parameters.

C. Remove and replace units that do not pass tests or inspections and retest as specified above.

3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.

C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262200

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

B. Related Sections include the following:

1. Division 23 Section "Sequence of Operations for HVAC Controls" for BAS monitoring requirements, including equipment and parameters to be monitored.

1.3 DEFINITIONS

A. SVR: Suppressed voltage rating.

B. SPD: Surge Protection Device.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

6. Include wiring diagrams for power, signal, and control wiring.
7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.5 INFORMATIONAL SUBMITTALS

A. 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.

B. Panelboard Schedules: For installation in panelboards.

1.6 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 Section 017823 "Operation and Maintenance Data," 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.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

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 third party agency that shall be amongst those accredited by the SCBCC (South Carolina Building Code Council), , and marked for intended location and application.

D. Series rating of panelboards is not acceptable.

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

1.8 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 NEMA PB 1.

1.9 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete.
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 6600 feet.

1.10 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Final Acceptance.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. All panelboards, switchboards, circuit breakers, dry type transformers and disconnect switches shall be of the same manufacturer.

B. All branch breakers over 100A and all main breakers in panelboards on the life safety, legally required and optional standby systems shall have LSI (long time, short time and instantaneous) settings.

C. Enclosures: Flush and surface-mounted cabinets as indicated on the drawings.

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 Areas: NEMA 250, Type 4X, stainless steel.
d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2. Piano Type Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
3. Finishes:

a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
b. Back Boxes: Galvanized steel.

4. Directory Card: Inside panelboard door, mounted in transparent card holder.

D. Incoming Mains Location: Top or bottom to match incoming conduit location.

E. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
3. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
4. Split Bus: Vertical buses divided into individual vertical sections.

F. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Mechanical type.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type.

4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

G. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

H. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

I. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

J. All doors shall be keyed alike.

2.2 PERFORMANCE REQUIREMENTS

A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

2.3 DISTRIBUTION PANELBOARDS

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

1. Eaton Electrical Sector; Eaton Corporation.
2. General Electric Company.
3. Siemens Industry, Inc.
4. Square D.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches high, provide two latches, keyed alike.

D. Mains: Circuit breaker or Lugs only per drawings.

E. Branch Overcurrent Protective Devices: Bolt-on circuit breakers.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

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

1. Siemens Industry, Inc.
2. General Electric Company.
3. Square D.
4. Eaton Electrical Sector; Eaton Corporation.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only per the drawings.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

F. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

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. Eaton Electrical Sector; Eaton Corporation.
2. General Electric Company.
3. Siemens Industry, Inc.
4. Square D.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. 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 time adjustments.
    d. Ground-fault pickup level, time delay, and I squared x t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor
    c. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
    d. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
    e. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
    f. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.
    g. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses: Comply with requirements specified in Section 262813 "Fuses."
2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Equipment Mounting:
1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2. Install anchor bolts to elevations required for proper attachment to panelboards.
3. Attach panelboard to the vertical finished or structural surface behind the panelboard.

C. 90 inches to top of trim above finished floor unless otherwise indicated or as required to ensure that the operating handle of the top most switch or circuit breaker is not higher than 79" above the finished floor level.

D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

E. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

F. Install filler plates in unused spaces.

G. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

H. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform service disconnect ground-fault test by a qualified person(s) using a test process of primary current injection in accordance with NEC 230.95.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study.

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Weather-resistant receptacles.
4. Snap switches and wall-box dimmers.
5. Wall-switch and exterior occupancy sensors.

B. All receptacles, attachment plugs, and similar wiring devices shall be of the general use type

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. SPD: Surge Protective Device.

F. UTP: Unshielded twisted pair.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Cooper Wiring Devices, Inc.
2. Hubbell.
3. Leviton Manufacturing Co., Inc.
4. Pass & Seymour/Legrand (Pass & Seymour).

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a third party agency that shall be amongst those accredited by the SCBCC (South Carolina Building Code Council), and marked for intended location and application.

B. Comply with NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

D. All receptacles shall be federal specification grade.

2.3 STRAIGHT-BLADE RECEPTACLES

A. All receptacles shall be federal specification grade.

B. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

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. Cooper Wiring Devices, Inc.
b. Hubbell.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2.4 GFCI RECEPTACLES

A. General Description:

1. Straight blade, feed]through type.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

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. Cooper Wiring Devices, Inc.
b. Hubbell.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2.5 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.

1. 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. Cooper Wiring Devices, Inc.
b. Hubbell.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description:

a. Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.
b. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.6 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

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

a. Single Pole:

1) Cooper; AH1221.
2) Hubbell; HBL1221.
3) Leviton; 1221-2.
4) Pass & Seymour; CSB20AC1.

b. Two Pole:

1) Cooper; AH1222.
2) Hubbell; HBL1222.
3) Leviton; 1222-2.
4) Pass & Seymour; CSB20AC2.

c. Three Way:

1) Cooper; AH1223.
2) Hubbell; HBL1223.
3) Leviton; 1223-2.
4) Pass & Seymour; CSB20AC3.

d. Four Way:

1) Cooper; AH1224.
2) Hubbell; HBL1224.
3) Leviton; 1224-2.

4) Pass & Seymour; CSB20AC4.

C. Key-Operated Switches, 120/277 V, 20 A:

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. Cooper Wiring Devices, Inc.
b. Hubbell.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Single pole, with factory-supplied key in lieu of switch handle.

D. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors.

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. Cooper Wiring Devices, Inc.
b. Hubbell.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

E. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

1. 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. Cooper Wiring Devices, Inc.
b. Hubbell.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2.7 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.

C. LED Dimmer Switches: Modular; compatible with dimmer drivers; trim potentiometer to adjust low-end dimming; dimmer-driver combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.8 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic Material for Unfinished Spaces: Galvanized steel.

2.9 FINISHES

.

1. Wiring Devices Connected to Emergency Power System: [Red] <Insert color>.
2. SPD Devices: Blue.

B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, 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 meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

    a. Cut back and pigtail, or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

.

A. Perform the following tests and inspections:

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
2. Test Instruments: Use instruments that comply with UL 1436.
3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is 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.

C. Wiring device will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Interior solid-state luminaires that use LED technology.
2. Exit Signs
3. Lighting fixture supports.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 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 and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 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 IES LM-79.

    a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

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.
4. Confirmation of compliance with Design Lighting Consortium (DLC) or ENERGY STAR product requirements.

C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Product Certificates: For each type of luminaire.

C. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.

D. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.9 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: Five year(s) from date of Final Acceptance.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
2. Battery and Charger Data: One for each emergency lighting unit.
3. Ballasts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
4. Drivers: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
5. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.
6. Exit signs: Provide 10 additional exit signs (single face or double face, as needed) including 100' of conduit, boxes, wire, associated accessories and installation for each. Exit signs shall be installed as directed by the Architect, Owner, or Authority Having Jurisdiction (AHJ). Any unused additional exit signs shall be turned over to the Owner in their original boxes.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

A. Manufacturers: Subject to compliance with requirements, provide products as scheduled on the drawings.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a third party agency that shall be amongst those accredited by the SCBCC (South Carolina Building Code Council), and marked for intended location and application.

C. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

D. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

E. Recessed Fixtures: Comply with NEMA LE 4.

F. Bulb shape complying with ANSI C79.1.

G. Lamp base complying with ANSI C81.61.

H. CRI of minimum 80. CCT of 4000 K.

I. Rated lamp life of 50,000 hours.

J. Lamps dimmable from 100 percent to 0 percent of maximum light output.

K. Internal driver:
1. Minimum efficiency: 85% at full load.
2. Minimum Operating Ambient Temperature: -20˚ C. (-4˚ F.).
3. Input Voltage: 120 - 277V (±10%) at 60 Hz.
4. Integral short circuit, open circuit, overload protection and minimum 2-KV surge protection integral with the driver.
5. Power Factor: ≥ 0.95.
6. Total Harmonic Distortion: ≤ 20%.
7. Comply with FCC 47 CFR Part 15.

L. LED Modules:
1. Comply with IES LM-79 and LM-80 requirements.
2. Minimum CRI 80 and color temperature 4000˚ K unless otherwise specified in LIGHTING FIXTURE SCHEDULE.
3. Minimum Rated Life: 50,000 hours per IES L70.
4. Light output lumens as indicated in the LIGHTING FIXTURE SCHEDULE.

M. Nominal Operating Voltage: 277 V ac.

N. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

O. Housings:

1. Extruded-aluminum housing and heat sink.
2. Clear anodized powder-coat finish.

P. All interior LED lighting fixtures shall be compliant with current product requirements of Design Lighting Consortium (DLC) or ENERGY STAR program.

2.2 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
   1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
   2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
      a. Charger: Fully automatic, solid-state type with sealed transfer relay.
      b. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
      c. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
      d. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
      e. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

C. Provide Five (5) extra exits signs for installation as directed by the Architect. Installation costs for these shall be included in the bid. Unused exit signs shall be turned over to the owner.

2.3 MATERIALS

A. Metal Parts:

   1. Free of burrs and sharp corners and edges.
   2. Sheet metal components shall be steel unless otherwise indicated.
   3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

2.4 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.5 LUMINAIRE FIXTURE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, [12 gage] <Insert size>.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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.

3.3 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position 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 vertical force of 400 percent of luminaire weight.

E. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
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. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. 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.

G. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. 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.

C. Luminaire will be considered defective if it does not pass operation tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 265119

SECTION 284600 - ADDRESSABLE FIRE-ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. System smoke detectors.
2. Heat detectors.
3. Notification appliances.

1.3 DEFINITIONS

A. EMT: Electrical Metallic Tubing.

B. FACP: Fire Alarm Control Panel.

C. NICET: National Institute for Certification in Engineering Technologies.

D. PC: Personal computer.

1.4 ACTION SUBMITTALS

A. 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.

B. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.

6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:

a. Trained and certified by manufacturer in fire-alarm system design.
b. NICET-certified, fire-alarm technician.
c. Licensed or certified by authorities having jurisdiction.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
d. Riser diagram.
e. Device addresses.
f. Record copy of site-specific software.
g. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

1) Equipment tested.
2) Frequency of testing of installed components.

3) Frequency of inspection of installed components.
4) Requirements and recommendations related to results of maintenance.
5) Manufacturer's user training manuals.

h. Manufacturer's required maintenance related to system warranty requirements.
i. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm technician.

C. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL (nationally recognized testing laboratory).

1.8 COORDINATION

A. Coordinate with existing Simplex 4010 fire alarm system.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with, and operate as an extension of, existing system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.

B. Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn/strobe evacuation.

C. Automatic sensitivity control of certain smoke detectors.

D. All components provided shall be listed for use with the selected system.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices:

1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Automatic sprinkler system water flow.
5. Fire standpipe system.
6. Dry system pressure flow switch.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm and specific initiating device at fire-alarm control unit and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Release fire and smoke doors held open by magnetic door holders.
6. Recall elevators to primary or alternate recall floors.
7. Activate emergency lighting control.
8. Record events in the system memory.
9. Indicate device in alarm on the graphic annunciator.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. Elevator shunt-trip supervision.
3. User disabling of zones or individual devices.
4. Loss of communication with any panel on the network.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.

E. System Supervisory Signal Actions:

1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit and remote annunciator.

3. After a time delay of **300 seconds**, transmit a trouble or supervisory signal to the remote alarm receiving station.
4. Transmit system status to building management system.
5. Display system status on graphic annunciator.

2.3 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be two-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type, indicating detector has operated.
7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

2.4 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

1. Temperature sensors shall test for and communicate the sensitivity range of the device.

B. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.5 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.

C. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.

1. Rated Light Output:

a. 15/30/75/110 cd, selectable in the field.

2. Mounting: Wall mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, red.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

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.

3.2 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, SCFC, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.

C. Smoke- or Heat-Detector Spacing:

1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
3. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A in NFPA 72.
4. HVAC: Locate detectors not closer than 60 inches from air-supply diffuser or return-air opening.
5. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

D. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

E. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.

F. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

G. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.

3.3 PATHWAYS

A. Pathways shall be installed in EMT.

B. Exposed EMT shall be painted red enamel.

3.4 CONNECTIONS

A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke-control system panel.
2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
3. Magnetically held-open doors.
4. Alarm-initiating connection to elevator recall system and components.
5. Alarm-initiating connection to activate emergency lighting control.

6. Supervisory connections at elevator shunt-trip breaker.
7. Data communication circuits for connection to building management system.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals.

B. Install framed instructions in a location visible from fire-alarm control unit.

3.6 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.7 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Visual Inspection: Conduct visual inspection prior to testing.

    a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.

2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Test audible appliances according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test visible appliances according to manufacturer's written instructions.
5. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

E. Fire-alarm system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

H. 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.

3.8 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall 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 shall be manufacturer's authorized replacement parts and supplies.

1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.9 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.10 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 284621.11

SECTION 323113
CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

C. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.

D. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

E. ASTM F567 - Standard Practice for Installation of Chain-Link Fence.

F. ASTM F668 - Standard Specification for Polyvinyl Chloride (PVC), Polyolefin and Other Polymer-Coated Steel Chain Link Fence Fabric.

G. CLFMI WLG 2445 - Wind Load Guide for the Selection of Line Post and Line Post Spacing.

H. FS RR-F-191/1D - Fencing, Wire and Post Metal (Chain-Link Fence Fabric).

1.02 SUBMITTALS

A. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.

B. Design Calculations: Provide calculations for line post size and spacing, gate sizing, and foundation details. Refer to CLFMI WLG 2445 and ASTM F 1043 for line post and spacing guidance.

C. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components.

D. Samples: Provide manufacturer's standard color charts for polymer coating.

1.03 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL

A. Fence Height: 6 feet (72 inches) above grade.

B. Performance Requirements:

1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set for fence height(s) indicated, according to ASCE 7.
    a. Design Wind Loads: Comply with requirements of ASCE 7 and wind loads indicated on Drawings.
2. Post Size and Spacing: Calculate per ASTM F 1043 or CLFMI WLG 2445 for fence height and material indicated. Do not exceed 10 foot post spacing. Minimum post and rail diameters are provided below.

2.02 MATERIALS

A. Posts, Rails, and Frames:
   1. Material: Group I round steel pipe galvanized in accordance with ASTM A123, at 2.0 ounces per square foot, or in accordance with ASTM A653 at 4.0 ounces per square foot.
   2. Line Posts: Type I round in accordance with FS RR-F-191/1D; minimum 1.9 inch diameter.
   3. Terminal, Corner, Rail, Brace, and Gate Posts: Type I round in accordance with FS RR-F-191/1D.
      a. Terminal, Corner, and Gate Posts: Minimum 2.38 inch diameter.
      b. Horizontal Rails and Bracing: Minimum 1.66 inch diameter.
      c. Gate Frame: Minimum 1.66 inch diameter.

B. Wire Fabric:
   1. ASTM F668 polymer-coated steel chain link fabric.
   2. Fabric: 2 inch diamond mesh interwoven wire, 6 gauge, 0.1920 inch thick, top selvage knuckle end closed, bottom selvage knuckle end closed.

C. Concrete:
   1. Ready-mixed, complying with ASTM C94/C94M; normal Portland cement; 3,000 psi strength at 28 days, 3 inch slump; 1 inch maximum size aggregate.

2.03 MANUAL GATES AND RELATED HARDWARE

A. General: Provide gates in accordance with ASTM F 900, with gate frames and fabric matching materials and finishes for fence posts, rails, and fabric.

B. Hardware for Single Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches high, 3 for taller gates; fork latch with gravity drop and padlock hasp; keeper to hold gate in fully open position.

C. Hinges: Finished to match fence components.
   1. Brackets: Round.
   2. Mounting: Center.
   3. Closing: Manual.

D. Latches: Finished to match fence components.
   1. Brackets: Round.
   2. Locking: Mechanical.

2.04 ACCESSORIES

A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.

B. Fittings: Provide sleeves, bands, clips, rail ends, clamps, tension bars, fasteners and other fittings as required for complete chain-link assembly; galvanized steel.

C. Tie Wire: Aluminum alloy steel wire.

2.05 FINISHES

A. Components (Other than Fabric): Galvanized in accordance with ASTM A123/A123M, at 2.0 ounces per square foot.

B. Hardware: Hot-dip galvanized to weight required by ASTM A153/A153M.

C. Accessories: Same finish as framing.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that all adjacent sitework is complete and that grade is at final level prior to installation of fencing and gates.

3.02 PREPARATION

A. Stake locations of fences and gates prior to installation. Verify locations of underground utilities and ensure that post footings will not disturb underground items, and adjust post locations as required to avoid conflicts.

3.03 INSTALLATION

A. Install framework, fabric, accessories and gates in accordance with ASTM F567.

B. Place fabric on outside of posts and rails.

C. Set intermediate, terminal, and gate posts plumb , in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.

D. Post Footing Depth Below Finish Grade: In accordance with ASTM F567, but no less than 30 inches below grade.

E. Brace each gate and corner post to adjacent line post with horizontal center brace rail. Install brace rail one bay from end and gate posts.

F. Do not stretch fabric until concrete foundation has cured 28 days.

G. Fasten fabric to top and bottom rails, line posts, braces, and tension wire with tie wire at maximum 15 inches on centers.

H. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.

I. Where a gate is indicated directly next to building wall, do not attach the hinged side of gate to building wall; provide a gate post.

J. Install hardware and gate(s) with fabric to match fence.

K. Peen all bolts upon installation.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch.

B. Maximum Offset From True Position: 1 inch.

END OF SECTION 323113