QUACKENBUSH ARCHITECTS + PLANNERS

Project Manual

Coastal Carolina University

PGA Golf Management Program Academic Learning Lab Construction

Conway, South Carolina

State Project Number	**H17-9623-MJ**
Architect's Project Number	22.304.00

CONSTRUCTION DOCUMENTS-FINAL
04.10.24

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PROJECT NUMBER: H17-9623-MJ

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Appendix 1 Existing Hazardous Material Information

PROJECT DIRECTORY

OWNER	Coastal Carolina University 755 Hwy 544 Conway, SC 29526 Attention: Shawn Godwin
ARCHITECT OF RECORD	Quackenbush Architects + Planners 1217 Hampton Street Columbia, South Carolina 29201 p.(803) 771-2999 Attention: Barbara Haller
CIVIL ENGINEER	Development Resource Group (DRG) 4703 Oleander Drive Myrtle Beach, SC, 29577 p. (843) 839-3350 Attention: Cam Parker
LANDSCAPE ARCHITECT	TrueDesign Studio 7224 N. Kings Hwy Myrtle Beach, SC 29571 p. (843) 855-1154 Attention: Nick Peters
FOOD SERVICE	National Restaurant Design 17770 Peppard Drive Fort Myers Beach, FL 33931 T: 216.429.8682 Attention: Greg Ballington
STRUCTURAL ENGINEER	Weatherly Structural Engineers 514 Alder Street, Suite 2 Box B Myrtle Beach, SC 29577 T: 843.448.3428 Attention: Ashleigh Weatherly
MECHANICAL ENGINEER PLUMBING ENGINEER FIRE PROTECTION ENGINEER	RMF Engineering 194 Seven Farms Drive, Suite G Charleston, SC 29492 (843) 971-9639 Attention: Zachary Lander
ELECTRICAL ENGINEER	RMF Engineering 194 Seven Farms Drive, Suite G Charleston, SC 29492 (843) 971-9639 Attention: Beth Crutchfield

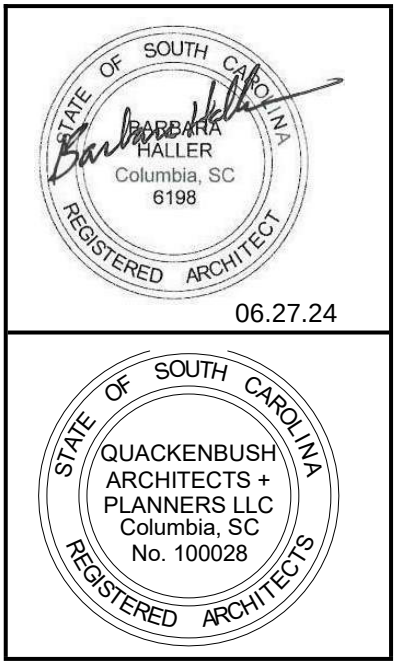
COMMISSIONING	Whole Building Systems PO Box 1845 Mt Pleasant, SC 29465 Attention: Tom Smith

DOCUMENT 000107 - SEALS PAGE

1.1 DESIGN PROFESSIONALS OF RECORD

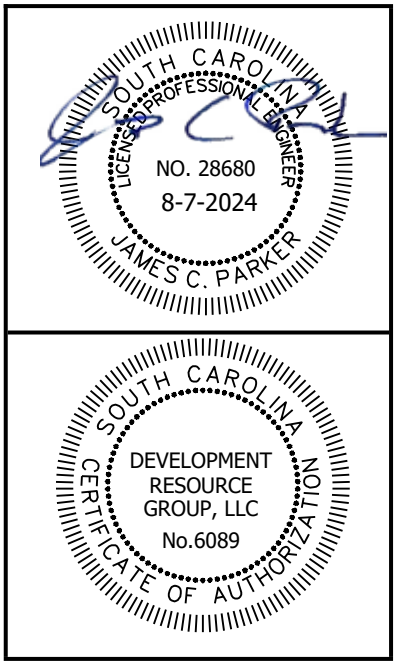
ARCHITECT

Quackenbush Architects + Planners
Barb Haller, AIA
Division 0-14, unless listed below.
313116, 323124



CIVIL ENGINEER

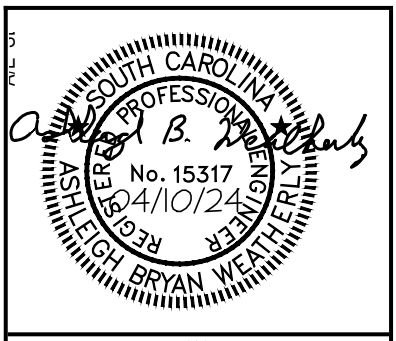
DESIGN RESOURCE GROUP
The following sections: 030000, Division 31, 32, 33 (unless listed elsewhere)

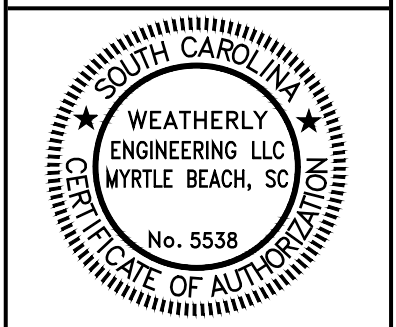


LANDSCAPE ARCHITECT	**TrueDesign Studio** **The following sections:** 321400, 328400, 329200, 329300

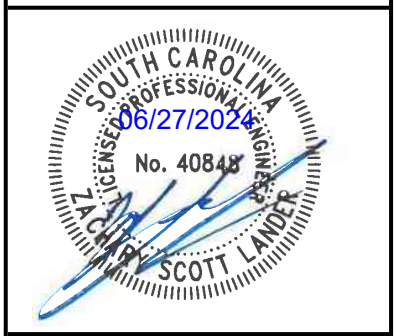


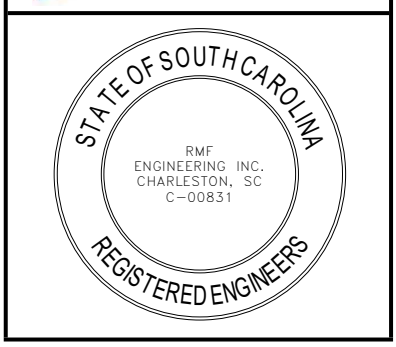
STRUCTURAL ENGINEER	**Weatherly Structural Engineers** **The following sections:** 033000, 042000, 051200, 053100, 054000, 054400





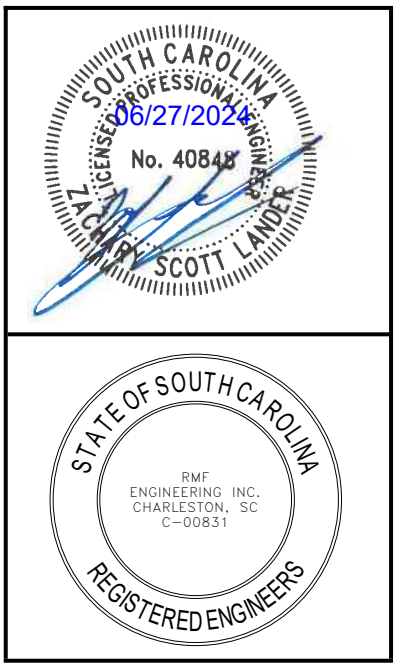
MECHANICAL ENGINEER	**RMF Engineering** **The following sections:** Division 26





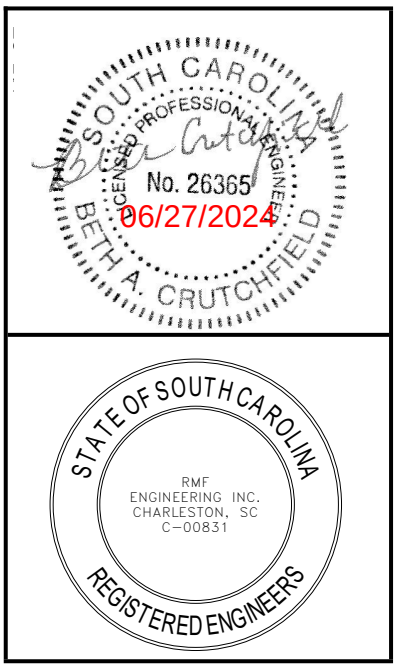
PLUMBING ENGINEER

RMF Engineering
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Division 22



ELECTRICAL ENGINEER

RMF Engineering
The following Sections:
Division 26, 27, 28



END OF DOCUMENT 000107

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

AGENCY: Coastal Carolina University

PROJECT NAME: PGA Golf Management Program Academic Learning Lab Construction

PROJECT NUMBER: H17-9623-CB **CONSTRUCTION COST RANGE:** $9,000,000 **to** $9,300,000

PROJECT LOCATION: PGA Golf Management Program Academic Learning Lab

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

Project is a golf management and academic learning lab building consisting of roughly 15,975 SF. It will serve as a teaching/working lab with classrooms and hands on spaces that serve the golf course functions. A kitchen and dining area will also be included.

BID/SUBMITTAL DUE DATE: 06/10/2025 **TIME:** 02:00 PM **NUMBER OF COPIES:** 1

PROJECT DELIVERY METHOD: Design-Bid-Build

AGENCY PROJECT COORDINATOR: Shawn Godwin

EMAIL: sgodwin@coastal.edu **TELEPHONE:** (843) 349-2672

DOCUMENTS OBTAINED FROM: https://www.coastal.edu/facilities/projects/

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: Quackenbush Architects-Planners **A/E CONTACT:** Barbara Haller

EMAIL: bhaller@quackenbusharchitects.com **TELEPHONE:** (803) 771-2999

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

PRE-BID DATE: 05/27/2025 **TIME:** 10:00 AM

PRE-BID PLACE: Hackler Golf Course Club House - Joe Carter Way, Conway, SC 29526

BID OPENING PLACE: Facilities 1 (Winyah House) 755 Highway 544, Conway, SC 29526

BID DELIVERY ADDRESSES:

HAND-DELIVERY:

Attn: Shawn Godwin
755 Highway 544
Conway, SC 29526

MAIL SERVICE:

Attn: Shawn Godwin
PO Box 261954
Conway, SC 29528

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

APPROVED BY:  **DATE:** 05/14/2025

(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)
PGA Golf Management Program Academic Learning Lab Const
H17-9623-MJ
Hackler Golf Course, 107 Citadel Dr, Conway, SC 29526

THE OWNER:
(Name, legal status, address, and other information)
Coastal Carolina
755 Highway 544
Conway, SC 29526

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)
Quackenbush Architects + Planners
1217 Hampton Street
Columbia, SC 29201

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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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Init.

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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: Facilities and Management Lobby
Building Where Posted: Winyah Houses
Address of Building: 755 Highway 544, Conway, SC 29526
WEB site address (if applicable): http:\\www.coastal.edu\facilities\projects\
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
Drawings titled	CCU PGA Drawings	

.5 Specifications

Section	Title	Date	Pages
Specifications titled	CCU PGA Project Manual		

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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

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BID BOND

BID BOND is the AIA document A310, latest edition, published by the American Institute of Architects.

The A310 document is not included, but may be viewed at the Architect's office or purchased from the American Institute of Architects.

END OF SECTION

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: Coastal Carolina University

(Agency's Name)

FOR: PROJECT NAME: PGA Golf Management Program Academic Learning Lab Construction

PROJECT NUMBER: H17-9623-MJ

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)*****:** Approximately 16,000 square foot two story building including classrooms, pro-shop, dining area and kitchen. Work includes but is not limited to sitework, landscape, masonry, structural steel, storefront, interior fnishes, food service equipment, elevator, electrial, mechanical, plumbing and fire protection. Demolition of existing clubhouse. Two Green Globes.

$ _____, 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)*: Outdoor Seating Area (Specification 012300)

☐ **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)*: Demolition and Abatement of existing clubhouse (024119 Selective Demolition with abatement requirements and Appendix 1 - Existing Hazardous Material Information)

☐ **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.	Unsuitable Soils	25 CY	$	$
2.	Trench Rock Excavation	50 CY	$	$
3.	Concrete or Asphalt Patching	10 SF	$	$
4.	Concrete Sidewalks	20 SF	$	$
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 the following page BF-2A)

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

(A) SUBCONTRACTOR LICENSE CLASSIFICATION or SUBCLASSIFICATION NAME *(Completed by Agency)*	(B) LICENSE CLASSIFICATION or SUBCLASSIFICATION ABBREVIATION *(Completed by Agency)*	(C) SUBCONTRACTOR and/or PRIME CONTRACTOR *(Required - must be completed by Bidder)*	(D) SUBCONTRACTOR'S and/or PRIME CONTRACTOR'S SC LICENSE NUMBER *(Requested, but not Required)*
BASE BID			
Mechanical	(AC)		
Plumbing	(PB)		
Electrical	(EL)		
ALTERNATE #1			
ALTERNATE #2			
ALTERNATE #3			

If a Bid Alternate is accepted, Subcontractors listed for the Bid Alternate shall be used for the work of both the Alternate and the Base Bid work.

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 himself) Bidder will use to perform this work.
   a. **Columns A & B**: The Agency fills out these columns to identify the subcontractor license classification / subclassification and related license abbreviation for which the Bidder must list either a subcontractor or himself as the entity that will perform this work. In Column A, the subcontractor license classification/subclassification is identified by name and in Column B, the related contractor license abbreviation (per Title 40 of the SC Code of Laws) is listed. 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 C and D:** In these columns, the Bidder identifies the subcontractors it will use for the work of each license listed by the Agency in Columns A & B. 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. Likewise, 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 Columns A & B. The subcontractor license must also be within the appropriate license group for the work. 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 must, except with the approval of the Agency for good cause shown, use the listed entities to perform the work for which they are listed.
7. 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.
8. Bidder's failure to identify an entity (subcontractor or himself) to perform the work of a subcontractor listed in Columns A & B 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 **400** 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

This version of AIA Document A101®–2017 is modified by the South Carolina Division of Procurement Services, Office of State Engineer ("SCOSE"). Publication of this version of AIA Document A101–2017 does not imply the American Institute of Architects' endorsement of any modification by SCOSE. A comparative version of AIA Document A101–2017 showing additions and deletions by SCOSE is available for review on the SCOSE Web site.

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)

Coastal Carolina University
755 Highway 544
Conway, SC 29526

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)

PGA Golf Management Program Academic Learning Lab Const
H17-9623-MJ
Hackler Golf Course, 107 Citadel Dr, Conway, SC 29526

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

Quackenbush Architects + Planners
1217 Hampton Street
Columbia, SC 29201

The Owner and Contractor agree as follows.

This version of AIA Document A101–2017 is modified by the South Carolina Division of Procurement Services, Office of State Engineer. Publication of this version of AIA Document A101 does not imply the American Institute of Architects' endorsement of any modification by South Carolina Division of Procurement Services, Office of State Engineer. A comparative version of AIA Document A101–2017 showing additions and deletions by the South Carolina Division of Procurement Services, Office of State Engineer is available for review on South Carolina state Web site.

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.)

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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: Rein Mungo

Title: Director, Facilities Planning and Management

Address: 755 Highway 544, Conway, SC 29526

Telephone: 843-349-2577

Email: tmungo@coastal.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: Shawn Godwin

Title: Project Manager, Facilities Planning and Construction

Address: 755 Highway 544, Conway, SC 29526

Telephone: 843-349-2672

Email: sgodwin@coastal.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: Barbara Haller

Title: Project Manager

Address: 1217 Hampton Street, Columbia, SC 29201

Telephone: 803-771-2999

Email: bhaller@quackenbusharchitects.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)

PGA Golf Management Program Academic Learning Lab Const
H17-9623-MJ
Hackler Golf Course, 107 Citadel Dr, Conway, SC 29526

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)

Coastal Carolina University
755 Highway 544
Conway, SC 29526

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.

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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

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.)

§ 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 NA ($) per claim and NA ($) 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 NA ($) per claim and NA ($) 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
NA	

§ 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
NA	

§ 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.)

NA

§ 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%
Performance Bond	100%

§ 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:

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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)

PGA Golf Management Program Academic Learning Lab Const
H17-9623-MJ
Hackler Golf Course, 107 Citadel Dr, Conway, SC 29526

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

Coastal Carolina University
755 Highway 544
Conway, SC 29526

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)

Quackenbush Architects + Planners
1217 Hampton Street
Columbia, SC 29201

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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 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 prior to submitting them for review and approval.

.2 The fire sprinkler shop drawings shall be reviewed and approved by the Architect's engineer of record (EOR) prior to submittal to the Office of State Fire Marshal (OSFM).

.3 The EOR shall submit to OSFM in accordance with the OSFM process.

.4 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

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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: Coastal Carolina University

Address: P.O. Box 261954

Conway, SC 29528

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: PGA Golf Management Program Academic Learning Lab Construction

State Project Number: H17-9623-MJ

Brief Description of Awarded Work: Approximately 16,000 square foot two story building including classrooms, pro-shop, dining area and kitchen. Work includes but is not limited to sitework, landscape, masonry, structural steel, storefront, interior fnishes, food service equipment, elevator, electrial, mechanical, plumbing and fire protection. Demolition of existing clubhouse. Two Green Globes.

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

Name: Quackenbush Architects + Planners

Address: 1217 Hampton Street

Columbia, SC 29201

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_____ **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-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: Coastal Carolina University

Address: P.O. Box 261954

Conway, SC 29528

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: PGA Golf Management Program Academic Learning Lab Construction

State Project Number: H17-9623-MJ

Brief Description of Awarded Work: Approximately 16,000 square foot two story building including classrooms, pro-shop, dining area and kitchen. Work includes but is not limited to sitework, landscape, masonry, structural steel, storefront, interior fnishes, food service equipment, elevator, electrial, mechanical, plumbing and fire protection. Demolition of existing clubhouse. Two Green Globes.

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

Name: Quackenbush Architects + Planners

Address: 1217 Hampton Street

Columbia, SC 29201

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: Coastal Carolina University

PROJECT NAME: PGA Golf Management Program Academic Learning Lab Construction

PROJECT NUMBER: H17-9623-MJ

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: Coastal Carolina University

PROJECT NAME: PGA Golf Management Program Academic Learning Lab Construction

PROJECT NUMBER: State Project No. H17-9623-MJ

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.

DOCUMENT 002600 - PROCUREMENT SUBSTITUTION PROCEDURES

1.1 DEFINITIONS

A. Procurement Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Procurement and Contracting Documents, submitted prior to receipt of bids.
B. Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Contract Documents, submitted following Contract award. See Section 012500 "Substitution Procedures" for conditions under which Substitution requests will be considered following Contract award.

1.2 QUALITY ASSURANCE

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

1.3 PROCUREMENT SUBSTITUTIONS

A. Procurement Substitutions, General: By submitting a bid, the Bidder represents that its bid is based on materials and equipment described in the Procurement and Contracting Documents, including Addenda. Bidders are encouraged to request approval of qualifying substitute materials and equipment when the Specifications Sections list materials and equipment by product or manufacturer name.
B. Procurement Substitution Requests will be received and considered by Owner when the following conditions are satisfied, as determined by Architect; otherwise requests will be returned without action:

    1. Extensive revisions to the Contract Documents are not required.
    2. Proposed changes are in keeping with the general intent of the Contract Documents, including the level of quality of the Work represented by the requirements therein.
    3. The request is fully documented and properly submitted.

1.4 SUBMITTALS

A. Procurement Substitution Request: Submit to Architect. Procurement Substitution Request must be made in writing in compliance with the following requirements:

    1. Requests for substitution of materials and equipment will be considered if received no later than 10 days prior to date of bid opening.
    2. Submittal Format: Submit one copies of each written Procurement Substitution Request, using form bound in Project Manual.

a. Provide certification by manufacturer that the substitute proposed is equal to or superior to that required by the Procurement and Contracting Documents, and that its in-place performance will be equal to or superior to the product or equipment specified in the application indicated.
b. Bidder, in submitting the Procurement Substitution Request, waives the right to additional payment or an extension of Contract Time because of the failure of the substitute to perform as represented in the Procurement Substitution Request.

B. Architect's Action:

1. Architect may request additional information or documentation necessary for evaluation of the Procurement Substitution Request. Architect will notify all bidders of acceptance of the proposed substitute by means of an Addendum to the Procurement and Contracting Documents.

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

END OF DOCUMENT 002600

SUBSTITUTION REQUEST FORM (During Bidding)

Project **CCU PGA Golf Facility**
Arch. Project No. 22.304.00

To Quackenbush Architects + Planners
1217 Hampton Street,
Columbia, South Carolina 29201

Email: bhaller@quackenbusharchitects.com
Attn Barb Haller, AIA
Phone 803.771.2999

Requested By _____

Contract For _____

Bid Date _____ **Substitution Request Date** _____

Section Name _____

Section No. _____ **Paragraph** _____

Related Dwgs. _____

Specified Product/Fabrication Method (List name/description; model no.; manufacturer)

_____

_____Required

Information for *Specified* Product	Attached
Point by Point Comparative Product Data	☐
Test	☐
Reports	☐
Fabrication Drawings	☐
Samples (Where Applicable)	☐

Proposed Product/Fabrication Method (List trade name/description; model no.; manufacturer)

_____

_____

Required Information for *Proposed* Product	Attached
Point by Point Comparative Product Data	☐
Test	☐
Reports	☐
Fabrication Drawings	☐
Samples (Where Applicable)	☐

Reason for Request

_____

_____

_____

_____

List of Related Changes/Modifications

_____

_____

_____

_____

Differences Between Proposed Substitution and Specified Product

_____

_____

_____

_____

Proposed Product/Fabrication Method Affects Other Parts of the Work **Yes** ☐ **No** ☐

Explain:

_____

_____

_____

_____

Proposed Product/Fabrication Method Affects the Construction Schedule **Yes** ☐ **No** ☐ **Explain:**

_____

_____

_____

_____

Undersigned Pays for Changes to the Building Design, including engineering and detailing costs Caused by the Requested Substitution **Yes** ☐ **No** ☐ **Explain:**

_____

_____

_____

_____

Attach Additional Sheets if Required

CERTIFICATE OF EQUAL PERFORMANCE AND
ASSUMPTION OF LIABILITY FOR EQUAL PERFORMANCE

Undersigned certifies:

1. Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product, except as noted herein.
2. Qualifications of manufacturer, installer, and other specified parties meet the specified qualifications.
3. Same special warranty will be furnished for proposed substitution as for specified product.
4. Same maintenance service and source for replacement parts, as applicable, is available as that specified.
5. Proposed substitution does not affect dimensions and functional clearances, except as noted herein.

Submitted By _____

Signed

_____

Firm

_____

Address _____

Telephone _____

Fax

_____

Signature shall be by person having authority to legally bind his firm to the above terms. Failure to provide legally binding signature will result in rejection of proposed substitution.

FOR QUACKENBUSH ARCHITECTS + PLANNERS USE ONLY

☐ Substitution Approved – Included in Addendum No._____

☐ Substitution Approved as Noted – Included in Addendum No._____

☐ Substitution Rejected – Use Specified Materials

☐ Substitution Request Received Too Late for Review Prior to Bid – Use Specified Materials

By_____ Date_____

DOCUMENT 003132 - GEOTECHNICAL DATA

1.1 GEOTECHNICAL DATA

A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information. This Document and its attachments are not part of the Contract Documents.

B. Because subsurface conditions indicated by the soil borings are a sampling in relation to the entire construction area, and for other reasons, the Owner, the Architect, the Architect's consultants, and the firm reporting the subsurface conditions do not warranty the conditions below the depths of the borings or that the strata logged from the borings are necessarily typical of the entire site. Any party using the information described in the soil borings and geotechnical report shall accept full responsibility for its use.

C. A geotechnical investigation report for Project, prepared by S&ME, Inc., dated August 4, 2023, is available for viewing as appended to this Document.

1. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.
2. Any party using information described in the geotechnical report shall make additional test borings and conduct other exploratory operations that may be required to determine the character of subsurface materials that may be encountered.

D. Related Requirements:
1. Document 003126 "Existing Hazardous Material Information" for hazardous materials reports that are made available to bidders.

END OF DOCUMENT 003132

Report of Geotechnical Exploration
(Rev. 1)
CCU PGA Golf Management
Academic Learning Lab
Conway, South Carolina
S&ME Project No. 22630133A

PREPARED FOR:
Coastal Carolina University
PO Box 261954
Conway, South Carolina 29526

PREPARED BY:
S&ME, Inc.
1330 Highway 501 Business
Conway, South Carolina 29526

August 4, 2023

August 4, 2023

Coastal Carolina University
PO Box 261954
Conway, South Carolina 29526

Attention: Mr. Mark Avant

Reference: **Report of Geotechnical Exploration (Rev. 1)**
CCU PGA Golf Management Academic Learning Lab
Conway, South Carolina
S&ME Project No. 22630133A

Dear Mr. Avant:

S&ME, Inc. has completed a supplemental subsurface exploration for the referenced project after receiving authorization to proceed via email from Mr. Shawn Godwin on July 10, 2023. Our exploration was conducted in general accordance with the Indefinite Delivery Contract (IDC) No. H17-D128-ID, between Coastal Carolina University and S&ME, dated January 2019, which is incorporated as part S&ME Proposal No. 22630133 dated July 21, 2022.

- This revision of our report (Rev. 1) considers the updated building location that was provided by Barb Haller (Quackenbush Architects) on June 27, 2023.
- This revision of our report supersedes and replaces the original report dated October 6, 2022.

The purpose of this study was to characterize the surface and subsurface soils on the proposed site, and to provide recommendations for site preparation, earthwork, foundation support for the proposed structures, and pavement section construction for the proposed development.

This report describes our understanding of the project, presents the results of the field exploration, laboratory testing, and engineering analysis and discusses our conclusions and recommendations based on these considerations. S&ME, Inc. appreciates this opportunity to be of service to you. Please contact us if you have questions concerning this report or any of our services.

Respectfully submitted,

S&ME, Inc.

Jeremy Lighthall
Geotechnical Staff Professional

SOUTH CAROLINA CERTIFICATE OF AUTHORIZATION S&ME, INC. No. C00473

Ronald P. Forest, Jr., P.E.
Principal Engineer
SC Registration No. 21248

SOUTH CAROLINA REGISTERED PROFESSIONAL ENGINEER No. 21248 8/4/23 RON FOREST JR.

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1.0 Executive Summary

For your convenience, this report is summarized in outline form below. This brief summary should not be used for design or construction purposes without thoroughly reviewing the information presented in the remainder of this report.

1. **Soil Conditions:** Beneath the topsoil at test locations C-1 through C-6 and underlying the asphalt at test locations HA-1 through HA-5, a stratum of undocumented fill (Stratum I) was encountered to depths ranging from 1 to 2 ½ feet. Beneath Stratum I at the test locations, an upper stratum of Coastal Plain sands (Stratum II) was encountered to the maximum exploration depths of 3 to 6 feet in the hand auger borings and to depths ranging from about 12 to 14 feet below the ground surface in the soundings. Beneath Stratum II the soundings encountered a stratum of soft to firm clays and silts (Stratum III) to depths ranging from about 19 to 26 feet below the ground surface. Beneath Stratum III in the soundings, a stratum of interbedded sands, silts, and clays (Stratum IV) was encountered to the maximum exploration depths of the soundings ranging from about 30.9 to 42.7 feet.
2. **Groundwater:** Based upon the pore pressure readings measured in the CPT soundings and water level measurements in the hand auger borings, the groundwater level at the time of our assessment was interpreted to be about 3 to 5 feet below the ground surface at the test locations. Groundwater levels may fluctuate seasonally at the site, being influenced by rainfall variation and other factors. Site construction activities can also influence groundwater elevations.
3. **Site Preparation:** The site should be stripped of asphalt/concrete, vegetation, debris, organic fill, and topsoil. Underground structures and existing utilities should be removed and re-routed around the footprints of the new construction. Due to the shallow groundwater conditions at the site, we recommend that drainage be established early in the grading phase of the project. Within the new building footprint the existing organic-laden fill soils should be stripped to the bottom of the organic-laden layer, observed at nominal depths of 24 to 29 inches, and spoiled. It may be possible to salvage some of the uppermost fill layer, since the organic content was typically greatest below a depth of 18 inches; however, the feasibility of this must be determined at the time of construction.

   After site drainage has been installed and prior to new fill placement, the stripped subgrade soils should be densified in-place at the cut grade elevation with a large vibratory roller. Static rolling may be necessary to prevent water from wicking up into the overlying soils. Some drying of the soils may be required during this process. The subgrade should be proofrolled by the contractor under the supervision of a representative of the Geotechnical Engineer (S&ME) and tested for proper compaction by an S&ME soils technician.

4. **Seismic Site Class:** Based on the apparent age and soil structure of the subsurface soils, liquefaction of the soil profile during seismic shaking was determined not to be a significant concern at this site, considering the anticipated ground accelerations associated with the design magnitude earthquake; therefore, Site Class F is not applicable. Test data indicates that this site is best described as IBC 2018/2021 (Code) seismic Site Class D based on the overall profile.

5. **Seismic Design Parameters and Seismic Design Category:** The following seismic design parameters are applicable to the site based on these assumptions: S_{DS} = 0.325g, S_{D1} = 0.182g, and site-modified Peak Ground Acceleration (PGA_M) = 0.245g. Based on these results, *Seismic Design Category C* applies to structures in Risk Categories I, II, and III.
6. **Shallow Building Foundations:** Considering maximum structural loads of 150 kips per column and 3 kips per linear foot of wall and about 150 pounds per square foot (psf) of uniformly applied area load to represent the weight of the applied floor slab loading (including the self-weight of the slab), a shallow foundation system appears feasible for support of the buildings with acceptable magnitudes of post-construction static settlement.

    - A net available soil bearing pressure of up to 2,500 pounds per square foot (psf) may be used for spread footing design, provided that the estimated post-construction static settlement magnitudes of up to 1 inch total and up to ½ inch differential settlement are considered tolerable, and the recommendations in this report are followed.
    - Some loose sands were observed in the upper few feet of the test soundings. Therefore, the client and contractor should be prepared for the possible need to either densify the bearing soils in place, or undercut the footing excavations on the order of 1 to 3 feet below their design bearing grade and replace the undercut material with coarse, clean, crushed gravel meeting the gradation requirements of SCDOT No. 57 or No. 67 stone. The depth of undercut required will depend somewhat on the bearing elevation of the footings as compared to existing grade and relative to the loose soil zones. This should be a decision made at the time of foundation construction based on bearing strength tests performed in the footing excavations by a representative of the Geotechnical Engineer.

7. **Grade Slabs:** Soil-supported thin slabs on grade may be designed using a modulus of subgrade reaction (k) of 225 pci, provided that the subgrade is prepared as recommended in this report. A capillary break layer consisting of at least 4 inches of granular materials should be placed immediately beneath the floor slab.
8. **Pavements:** For standard-duty flexible pavement areas subject to car traffic and light delivery vehicles only (e.g. UPS, FedEx), we recommend the following minimum pavement section: 2.0 inches of SCDOT Type C hot mixed asphalt (HMA) surface course over 6 inches of compacted graded aggregate base course (GABC). Thicken the asphalt by at least 1 additional inch along trash truck routes, if any. For standard-duty rigid pavement areas, we recommend the following minimum pavement section: 6 inches of unreinforced 4,000 psi Portland cement concrete (PCC), over 6 inches of compacted GABC.

2.0 Introduction

The purpose of this exploration was to obtain subsurface information to allow us to characterize the subsurface conditions at the site and to develop recommendations concerning grading, foundation design, and other related construction issues. This report describes our understanding of the project, presents the results of the field exploration and laboratory testing, and discusses our conclusions and recommendations.

A site plan showing the approximate test locations is included in Appendix I. The boring and sounding logs, a discussion of the field exploration procedures, and a legend to soil classification and symbols is included in Appendix II. The results of the laboratory testing are included in Appendix III.

3.0 Site and Project Description

3.1 Project Information

Project information was initially provided in email correspondence to Ron Forest, Jr. (S&ME) from Mr. Mark Avant (Coastal Carolina University) regarding the upcoming construction of a new PGA Golf Management Program Academic Learning Lab for the University. Mr. Avant provided Mr. Forest with a request for proposal (RFP) authored by Quackenbush Architects and dated July 15, 2022.

Updated project information, including an updated building location and site layout plan was provided by Barb Haller (Quackenbush Architects) on June 27, 2023.

3.2 Project Description

The proposed site is located at 107 Citadel Drive in Conway, South Carolina. The site is currently developed with the existing Hackler Course Hole 9, Clubhouse, and associated parking areas. A site vicinity map is included as Figure 1 in Appendix I.

Based on the original RFP, the proposed building is an approximately 18,000 SF two story building to be built on the site of the current building. The existing cart storage building will remain in place. The approximate finished floor elevation (FFE) of the new building will match the FFE of the existing building. Some pavement realignment work will occur in the adjacent parking lot and drive areas. The exterior skin of the new building will include brick veneer on stud back up, curtain wall and metal panels. The building will be either a steel-framed structure or load bearing CMU.

3.3 Design Data

3.3.1 Structural Loading Information

We understand that column loads may range from a minimum of 10 kips to a maximum of 150 kips and maximum wall loads are anticipated to be 3 kips per linear foot. Maximum slab on grade load is 150 psf. The loading information presented above should be reviewed by the project structural engineer and if actual loads are found

to be higher than those presented above, we should be given an opportunity to reevaluate settlement potential and recommended bearing pressure based on the revised loading scenarios.

3.3.2 Settlement Tolerances

We have not been provided with information relating to project settlement tolerances; therefore, we have assumed acceptable static settlement tolerances of 1 inch of total post-construction settlement and ½ inch of differential post-construction settlement.

3.3.3 Grade Elevation Changes

At the time of our supplemental site visit on July 24, 2023, the ground surface elevation at the new building location appears to have been cut down somewhat below the original golf course grade, to near the planned grade elevations for the new construction.

3.4 Updated Project Information

On June 27, 2023, we were provided an updated site layout plan by Barb Haller (Quackenbush Architects) indicating that the planned structure has been re-sited about 150 feet to the south of the original footprint on Hole 9 of the existing Hackler Golf Course, and as a result none of our original cone penetration test soundings C-1 through C-4 were located within the new building footprint.

We understand that structural loading and settlement tolerances have not changed since the original issuance of this report. As a result, the structural loading information and settlement tolerances in Sections 3.3.1 and 3.3.2 of this report still apply.

We were informed by Mrs. Haller on July 5, 2023, that grades were planned to be lowered about 4 feet from original grade, due to the topography of the golf course within the proposed building footprint. At the time of our supplemental field exploration on July 24, 2023, it appeared that Hole 9 of the golf course had already been shortened and the area within the new building footprint had already been cut to about level with the existing building and surrounding grades. Therefore, we assume that future grade changes will be relatively insignificant, with cuts or fills of less than 1 foot from the existing grades observed on July 24, 2023.

4.0 Exploration Program

4.1 Field Exploration

Between the dates of September 2nd and 6th, 2022 and on July 24, 2023, representatives of S&ME, Inc. visited the site. Using the information provided, we performed the following tasks.

1. Eleven (11) discrete test locations labeled C-1 through C-6 and HA-1 through HA-5 were established across the project site using GPS.

2. One Seismic Cone Penetration Test (SCPT) sounding, labeled C-3, was advanced to a depth of approximately 42.73 feet below the ground surface at which depth tooling encountered refusal on assumed cemented lenses.

    A. In conjunction with the SCPT sounding, shear wave velocity measurements were recorded at approximate 1 meter depth intervals. This sounding was used for seismic design considerations. See Figure 4 in Appendix I for the shear wave velocity profile.
    B. Cone Penetration Test (CPT) soundings C-1, C-2, C-5, and C-6 were advanced to depths ranging from 30.9 to 37.9 feet at which refusal was also encountered by tooling. Sounding C-4 was advanced to the target depth of 35 feet. The test locations are depicted on the Test Location Sketch, attached as Figure 2 in Appendix I.

3. In conjunction with the SCPT and CPT soundings, hand auger borings (C-1 through C-6 and C-5A) were performed at each test location. Hand auger borings C-1 through C-4 were advanced to a depth of 3 feet where saturated sands were encountered resulting in caving of the hand auger borings. Hand auger borings C-5A and C-6 were advanced to target depths of 6 feet, and caving did not occur. Hand auger boring C-5 was advanced to a depth of 1.1 feet, where auger refusal was encountered, likely on a large root. Grab samples of subsurface soil materials were collected from representative subsurface strata within the hand auger borings. Within the borings, our engineer observed and documented the subgrade soil types observed and subsurface water levels, where encountered.
4. Five (5) additional hand auger borings labeled HA-1 through HA-5 were advanced at the site within the site pavement areas. These borings also encountered saturated sands at a depth of 3 feet resulting in refusal with the exception of boring HA-3 which reached its target depth of 4 feet. Dynamic Cone Penetrometer (DCP) testing was performed at regular depth intervals of approximately 1 foot each within these hand auger borings beginning at the surface in general accordance with ASTM STP 399 procedures to help us estimate the relative density and consistency of the subgrade soils.

    - The DCP (single-mass) test procedure is as follows: The conical point of the penetrometer is seated into the bearing materials. Then the conical point is driven 1-3/4 inches using a 15-pound weight falling 20 inches. The penetrometer cone is driven two additional increments of 1-3/4 inches each, while the number of blows required to advance the point are recorded for each increment. The average blow count of the last two increments is typically used to evaluate the relative soil consistency and strength conditions of the soil at the test locations.

5. Small grab samples and one 40 to 50-pound composite bulk sample were collected from the site for laboratory analysis.
6. Groundwater levels were not directly measured in the CPT soundings; the groundwater levels at these locations were interpreted based on pore pressure measurements. Groundwater was measured in the hand auger borings at the completion of the boring.

A brief description of the field exploration procedures performed, as well as a soil classification legend, and the SCPT and CPT sounding logs and hand auger boring logs are attached in Appendix II.

4.2 Laboratory Testing

After the recovered soil samples were brought to our laboratory, a geotechnical professional examined and/or tested each sample to estimate its distribution of grain sizes, plasticity, organic content, moisture condition, color, presence of lenses and seams, and apparent geologic origin in general accordance with ASTM D 2488, *"Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)"*. The resulting classifications are presented on the hand auger boring logs, included in Appendix II. Similar soils were grouped into representative strata on the logs. The strata contact lines represent approximate boundaries between soil types. The actual transitions between soil types in the field are likely more gradual in both the vertical and horizontal directions than those which are indicated on the logs.

We performed the following quantitative ASTM-standardized laboratory tests on recovered samples, to help classify the soils and formulate our conclusions and recommendations:

- One bulk sample and four grab samples were tested in general accordance with ASTM D 2216, "*Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass*", to measure the in-situ moisture content of the soil.
- One bulk sample and four grab samples were tested in general accordance with ASTM D 1140, "*Standard Test Methods for Amount of Material in Soils Finer than No. 200 (75-µm) Sieve*", to measure the percent clay and silt fraction.
- Two grab samples were tested in general accordance with ASTM D 2974, "*Standard Test Methods for Determining the Water (Moisture) Content, Ash Content, and Organic Material of Peat and Other Organic Soils*", to measure the content of undecayed or undecomposed vegetative matter in the soil.
- One bulk sample tested in general accordance with ASTM D 1557, "*Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort*" to characterize the compaction characteristics of the soil.
- One specimen from the bulk sample recompacted to approximately 95 percent of the modified Proctor maximum dry density and tested in general accordance with ASTM D 1883, "*Standard Test Methods for California Bearing Ratio (CBR) of Laboratory-Compacted Soils*", to evaluate the subgrade support characteristics of the soils.

The laboratory test results and a brief description of the laboratory procedures for the above listed tests are attached to this report in Appendix III.

5.0 Site and Surface Conditions

At the time of this exploration the project site consisted of the existing Hackler Course Clubhouse, Hole 9, and the associated paved parking area. Topsoil was encountered in hand auger borings C-1 through C-4 and measured to be approximately 3 inches in thickness. Topsoil may be thinner or thicker in unexplored areas of the site. Exposed silty sands with trace organics were encountered at the surface at test locations C-5 and C-6. Asphalt was encountered in borings HA-1 through HA-5 and ranged in thickness from 1 ½ to 2 ½ inches and averaged about 2 inches overall. The asphalt exhibited some distress in the form of potholes and fatigue cracking as shown in the photos below.

Figure 5-1: Typical Asphalt Surface Distress



Date: 9/2/2022

Photographer: Jonathan Prevatte

Location / Orientation	HA-3 facing southwest.
Remarks	Potholes and alligator cracking.

Figure 5-2: Typical Asphalt Surface Distress



Date: 9/2/2022

Photographer: Jonathan Prevatte

Location / Orientation	Boring HA-3 facing southeast.
Remarks	General cracking.

5.1 Topography

Based on the Google Earth® imagery, existing grades across the site appear to range from roughly 39 to 41 feet above mean sea level (MSL) across the site. These elevations are approximate and should not be used for design considerations. It was beyond the scope of this exploration to survey ground surface elevations.

5.2 Local Geology

The project site is located in the Atlantic Coastal Plain physiographic province, or more specifically, the lower Coastal Plain of South Carolina. The Coastal Plain extends from the eastern limit of the Piedmont ("Fall Line") eastward to the coast and consists of a wedge-shaped deposit of ancient marine sediments of the Late Cretaceous Period and younger. Coastal Plain soils comprise interbedded layers of normally-consolidated and over-consolidated limestone, gravels, sands, silts, and clays. This deposit ranges in thickness from near zero at the Fall Line to thousands of feet at the coast.

A review of local geologic mapping indicates that the site area lies within an area dominated topographically by a series of relic beach terraces, which progressively increase in surface altitude as they proceed inland. These terraces have been extensively mapped and correlated over wide areas. Surface soils penetrated by our borings

and soundings have been interpreted to be a part of the Socastee Formation, consisting of relatively recent marine deposits laid down approximately 200,000 years ago.

6.0 Subsurface Conditions

The generalized subsurface conditions at the site are described below. For more detailed descriptions and stratifications at test locations, the respective sounding and boring logs should be reviewed in Appendix II.

6.1 Interpreted Subsurface Profile

Two subsurface cross-sectional profiles of the site soils are attached as Figure 3 and Figure 3A in Appendix I to illustrate a general representation of the subsurface conditions in the proposed construction area. Profile A-A' is oriented generally southwest to northeast and shown as looking northwest; Profile B-B' is oriented generally west to east, and is shown as looking north. The orientation of the profiles in plan view are marked as A–A' and B-B' on Figure 2.

- Profile B-B' represents the interpreted subsurface soil profile through the new building footprint location.

The strata indicated in the profiles are characterized in the following section. Note that the profiles are not to scale and were prepared for illustrative purposes only. Subsurface stratifications may be more gradual than indicated, and conditions may vary between test locations. The strata encountered are labeled on the soil profiles to allow their properties to be systematically described.

6.2 Description of Subsurface Soils

This section describes subsurface soil conditions observed at the site, as illustrated on the profiles in Figures 3 and 3A of Appendix I. Soils encountered by the test soundings were grouped into general strata based on estimated physical properties derived from subsurface data and the recovered soil samples. The site subsurface soils were separated into four strata, labeled I through IV.

6.2.1 Stratum I: Undocumented Fill

Beneath the topsoil at the test locations C-1 through C-4, beneath the asphalt at test locations HA-1 through HA-5, and at the surface at test locations C-5 and C-6, a stratum of undocumented fill soils was encountered to depths ranging from about 1 to 2 ½ feet.

Based on samples collected from the hand auger borings, this fill soil stratum generally consists of silty sand (USCS Classification "SM"), poorly graded sand with silt (SP-SM), and poorly graded sand (SP). At test locations C-5 and C-6 within the new building footprint location at the former Hole 9, organic materials were observed to depths ranging from 13 inches, at which boring C-5 refused on a buried root, to depths of 24 and 29 inches respectively in borings C-6 and C-5A. In boring C-5A, an organic content test performed on a sample obtained from depths of 19 to 22 inches below the surface measured 7.0 percent by weight of organics. In boring C-6, an organic content test performed on a sample obtained from depths of 19 to 24 inches below the surface measured 4.1 percent by weight of organics. Typically, an organic content of greater than 5 percent is considered excessive.

The fill soils were observed to be moist with dark brown to brown and tan coloration. Some marine shell fragments were observed within this stratum. CPT tip resistance values ranged from approximately 15 to 80 tons per square foot (tsf), indicating a generally very loose to medium dense relative density. Conventional DCP penetration resistances in this stratum averaged greater than 20 blows per increment (bpi), indicating generally medium dense relative density.

Where measured, soils within this stratum exhibited natural moisture contents ranging from 10.6 percent to 19.7 percent and silt and clay fines content ranging from 4.7 percent to 14.3 percent by weight passing the No. 200 sieve.

6.2.2 Stratum II: Upper Coastal Plain Sands

Beneath the Stratum I fill soils at test locations C-1 through C-4, C-5A, C-6, and HA-1 through HA-5, an upper stratum of Coastal Plain sands were encountered to the termination depths ranging from 3 to 6 feet in the hand auger borings and to depths of about 12 to 14 feet below the ground surface in the soundings.

Based on samples collected from the hand auger borings, this stratum generally consists of poorly graded sand with silt (SP-SM), silty sand (SM), and clayey sand (SC). Trace organics were encountered within the clayey sands encountered at test location HA-3. Trace to some organics were encountered within the silty sands at test locations C-5, C-5A, and C-6. The soils were observed to be moist to wet with brown to dark brown, yellow tan, and gray coloration. CPT tip resistance values ranged from approximately 10 to 260 tsf, indicating a generally very loose to loose relative density. Conventional DCP penetration resistances in this stratum ranged from 4 bpi to greater than 20 bpi with an average blow count of 11 bpi, indicating generally medium dense relative density with some very loose to loose layers.

Where measured, soils within this stratum exhibited natural moisture contents ranging from 9.4 to 15.1 percent, and silt and clay fines contents ranging from 5.9 to 7.6 percent by weight passing the No. 200 sieve. An organic content of 2.9 percent by weight was measured on a sample obtained from hand auger boring HA-3 at depths of 2 to 3 feet. One bulk sample of soils collected from within this stratum was measured to have a modified Proctor maximum dry density of 116.6 pounds per cubic foot, at optimum moisture content of 8.8 percent. A California Bearing Ratio (CBR) value of 23.4 percent was measured on this sample when remolded to about 95 percent of the modified Proctor maximum dry density and soaked.

6.2.3 Stratum III: Intermediate Soft to Firm Clays and Silts

Beneath Stratum II in the soundings at test locations C-1 through C-6, a stratum of soft to firm clays and silts was encountered to depths ranging from about 19 to 26 feet below the ground surface. Some loose sand lenses were encountered within this stratum. CPT tip resistance values ranged from approximately 5 to 15 tsf, indicating a generally soft to firm consistency.

6.2.4 Stratum IV: Interbedded Sands, Silts, and Clays

Beneath Stratum III in the soundings at test locations C-1 through C-6, a stratum of interbedded sands, silts, and clays was encountered to the maximum exploration depth of 42.7 feet in the soundings. CPT tip resistance values ranged widely from approximately 15 tsf to over 400 tsf and were typically 25 to 40 tsf, indicating a generally

loose to medium dense relative density with occasional very loose to very dense layers in the sands and a generally stiff to hard consistency in the silts and clays.

6.2.5 Groundwater

Based upon the pore pressure readings measured in the CPT soundings, the groundwater level at the time of our exploration was interpreted to be about 3 feet in soundings C-1 through C-4. At test locations C-5, C-5A, and C-6, groundwater was interpreted to be about 4.5 to 4.8 feet below the ground surface. Groundwater was measured to be about 3 feet below the surface in hand auger borings C-1 through C-4 and HA-1 through HA-5 at the time of this exploration. Groundwater levels may fluctuate seasonally at the site, being influenced by rainfall variation and other factors. Site construction activities can also influence groundwater elevations.

6.2.6 Summary of Laboratory Test Results

We performed laboratory testing on one bulk sample and several grab samples to further assess the engineering index properties of the subsurface soils. The laboratory soil index test results are presented in Appendix III and are summarized in the following tables.

Table 6-1: Summary of Laboratory Soil Index Testing Results

Boring/ (Sample No.)	Sample Depth	Natural Moisture Content (%)	Silt/Clay Fines Content (%)	Organic Content	USCS Classification
HA-1 to HA-4/(Bulk)	1’ – 3’	15.1	5.9	---	SP-SM
HA-2/(S-1)	0.2’ – 0.5’	19.7	4.7	---	SP
HA-3/(S-1)	2’ – 3’	18.9	---	2.9	SC
C-3/(S-3)	2’ – 3’	9.4	7.6	---	SP-SM
C-6/(S-1)	0 – 0.5’	10.6	14.3	---	SM
C-5A/(S-3)	19” – 22”	19.3	---	7.0	SM
C-6/(S-2)	19” – 24”	16.3	---	4.1	SM
C-5A/(S-4)	29” – 34”	15.1	13.2	---	SM

Table 6-2: Summary of Moisture-Density and CBR Test Results

Boring /(Sample No.)	Modified Proctor Maximum Dry Density (pcf)	Modified Proctor Optimum Moisture Content (%)	CBR at 0.1 in. Penetration – 95.5% Compaction (%)
HA-1 to HA-4/(Bulk)	116.6	8.8	23.4

7.0 Seismic Site Class and Design Parameters

As of January 1, 2023, the 2021 edition of the International Building Code (IBC) has been adopted for use in South Carolina. We classified the site as one of the Site Classes listed in IBC, using the procedures described in Chapter 20 of ASCE 7-16.

7.1 Evaluation of the Potential for Site Class F Conditions

Seismic-induced ground shaking at the foundation is the effect taken into account by seismic-resistant design provisions of the International Building Code (IBC). Other effects, including landslides and soil liquefaction, must also be considered.

The initial step in site class definition is to check for the four conditions described for Site Class F, which would require a site-specific evaluation to determine site coefficients F_A and F_V. Soils vulnerable to potential failure include the following: 1) quick and highly sensitive clays or collapsible weakly cemented soils, 2) peats and highly organic clays, 3) very high plasticity clays, and 4) very thick soft/medium stiff clays. These soils were not evident in the borings or soundings.

One other determining characteristic, liquefaction potential under seismic conditions, was assessed. Soils were assessed qualitatively for liquefaction susceptibility based on their age, stratum, mode of deposition, degree of cementation, and size composition. This assessment considered observed liquefaction behavior in various soils in areas of previous seismic activity.

Our analysis, which is more fully described below, indicates that significant liquefaction of subsoils appears unlikely to occur at this site in the event of the design magnitude earthquake; therefore, Site Class F conditions do not reasonably apply to this site.

7.1.1 Average Shear Wave Velocity

Based on shear wave velocities measured at the site, we determined that site response factors F_A and F_V corresponding to Site Class D would be applicable to determine spectral values for design. This recommendation is provided based on the average weighted shear wave velocities measured to a depth of 42.7 feet at test location C-3 and extrapolated to a depth of 100 feet. The average shear wave velocity to a depth of 42.7 feet was measured to be 885 feet per second (fps), and the extrapolated shear wave velocity to a depth of 100 feet was estimated to be 901 fps, which is greater than the 600 feet per second that is required for consideration of Site Class D design parameters, but is less than the 1,200 fps that is required for consideration of Site Class C design parameters. See Figure 4 in Appendix I for the shear wave velocity profile used in this analysis.

7.1.2 Liquefaction of Bearing Soils

Liquefaction of saturated, loose, cohesionless soils occurs when they are subjected to earthquake loading that causes the pore pressures to increase and the effective overburden stresses to decrease, to the point where large soil deformation or even transformation from a solid to a liquid state results. Earthquake-induced ground surface acceleration at the site was assumed from the building code design peak ground acceleration of 0.245g.

7.1.2.1 Liquefaction Potential Index (LPI)

To evaluate liquefaction potential, we performed analyses using the data obtained in the borings, considering the characteristics of the soil and water levels observed in the boring. The liquefaction analysis was performed based on the design earthquake prescribed by the 2018 edition of the International Building Code, the "simplified procedure" as presented in Youd et al. (2001), and recent research concerning the liquefaction resistance of aged sands (Hayati & Andrus, 2008; Andrus et al. 2009; Hayati & Andrus, 2009).

To help evaluate the consequences of liquefaction, we have computed the Liquefaction Potential Index (LPI), which is an empirical tool used to evaluate the potential for liquefaction to cause damage. The LPI considers the factor of safety against liquefaction, the depth to the liquefiable soils, and the thickness of the liquefiable soils to compute an index that ranges from 0 to 100. An LPI of 0 means there is no risk of liquefaction; an LPI of 100 means the entire profile is expected to liquefy. The level of risk is generally defined below.

- ***LPI < 5*** – surface manifestation and liquefaction-induced damage not expected.
- ***5 ≤ LPI ≤ 15*** – moderate liquefaction with some surface manifestation possible.
- ***LPI > 15*** – severe liquefaction and foundation damage is likely.

The average LPI for this site was less than 5, which indicates that the risk of surface damage due to liquefaction is low and is not expected to occur across the site. Significant ground settlements during an earthquake caused by the volumetric compression of the sands are not expected. Therefore, Site Class F does not reasonably apply to this site.

7.2 Seismic Design Coefficients

The spectral accelerations and site coefficients for the site are given below in Table 7-1.

Table 7-1: Seismic Design Coefficients

Criteria	Site Class	S_S	S_1	S_{DS}	S_{D1}	PGA_M	Seismic Design Category*
General Procedure 2021 IBC/ ASCE 7-16	D	0.315	0.115	0.325	0.182	0.245	C

*applies to Risk Categories I, II, and III only.

7.2.1 Seismic Design Category

For a structure having a Risk Category classification of I, II, or III, the S_{DS} and S_{D1} values obtained are consistent with "Seismic Design Category C" as defined in section 1613.3.5 of the 2018 IBC.

8.0 Conclusions and Recommendations

The conclusions and recommendations included in this section are based on the project information outlined previously and the data obtained during our exploration. If the construction scope is altered, the locations of the structures changed, or if conditions are encountered during construction that differ from those encountered in the borings, then S&ME, Inc. should be retained to review the following recommendations based upon the new information and make any necessary changes.

Based upon the results of our exploration and our experience with similar soils in the site vicinity, the site appears generally adaptable for the proposed development. Based on the assumed loading and settlement tolerances, it appears feasible that the proposed structures can be supported on a shallow foundation system and do not require deep foundation support.

8.1 Demolition of Existing Structures

The following general recommendations are provided for the demolition of underground utilities in areas where they occur within the footprint of the proposed new structure:

1. Demolish existing asphalt or concrete if encountered, within the footprint of proposed new structures or foundations.
2. Following demolition of the existing concrete and structures, remove or plug existing utilities that are to be permanently abandoned. If not removed or plugged, pipes may serve as conduits for subsurface erosion resulting in formation of voids below foundations or grade slabs.
3. Reroute existing utilities that will remain in use around the proposed new structures and their foundations.
4. Areas excavated to remove any buried structures should be backfilled in accordance with Section 8.3 of this report.

As with any demolition project, there may be unexpected or unforeseen conditions encountered in the subsurface. In such cases, the Geotechnical Engineer shall be consulted.

8.2 Surface Preparation

The following recommendations are provided regarding site preparation and earthwork:

1. Strip the site surface of topsoil and vegetation and dispose of outside of the proposed building and pavement footprints. Based upon our exploration, organic-laden topsoil across the unpaved portions of the site outside of the Hole 9 golf course area appears to be approximately 3 inches in thickness; however, in the former Hole 9 area, organic-laden fill soils were observed to be as deep as 2 to 2 ½ feet. Stripping depths may vary in unexplored portions of the site and between test locations.

    - Do not locate debris piles within the construction areas.

2. It should be expected that overexcavation of at least some of the previously placed fill soils may be required in some areas of the site and in individual footing excavations to provide adequate support for the proposed structures and site pavements.

    - **UNDERCUTTING WITHIN THE NEW BUILDING FOOTPRINT:** Within the new building footprint in the former Hole 9 area, organic laden soils were encountered to depths of at least 13 inches in boring C-5, to a depth of 29 inches in boring C-5A, and to 24 inches in boring C-6. At test locations C-5A and C-6, the organic content appeared to be somewhat less near the surface than it was below depths of about 19 inches. Therefore, it may be possible to salvage some of the uppermost fill layer and stockpile it to the side for re-use before removing the organic-laden fill beneath it; however, for bid purposes, we recommend that you assume that this entire zone of material will need to be removed.
    - Any material that is salvaged and stockpiled to the side for later re-use as fill should be observed and tested by a representative of the Geotechnical Engineer to confirm its suitability for use as fill.
    - The contractor may wish to excavate several small, shallow test pits through the upper 2 ½ feet or so of the subgrade in this area to determine the potential for salvaging any of the uppermost fill material, and to gauge the depth of cut that will be needed to fully remove the organic-laden soils, since it should be recognized that our recommendation herein is based upon three small diameter borings, and actual conditions may vary considerably.
    - We anticipate that the organic laden soils may extend beneath the entire building pad or nearly so. Undercutting should extend 5 feet laterally beyond the limits of the new building footprint. Undercutting of the building pad should be observed by a representative of the Geotechnical Engineer, to confirm organic laden soils are removed, as well as to evaluate the suitability of the excavated fill for replacement.

3. Surface and subsurface water conditions at the time of construction, largely influenced by prevailing weather patterns, will determine the need for and extent of drainage measures. Due to shallow groundwater encountered at depths as shallow as 3 feet below the ground surface establishing drainage prior to beginning construction is imperative. Water conditions can change with construction activities and precipitation effects. Site drainage should be established prior to construction activities and maintained during construction activities. Generally, the depth to water observed during our September, 2022 exploration was about 1 ½ feet higher than the depth to water that we observed during the July, 2023 exploration, indicating seasonal variations in the perched groundwater level.
4. After the stripping and undercutting operation is complete and temporary site drainage has been installed, the exposed soil surface should be thoroughly densified in place by making several passes with a heavy vibratory roller prior to placement of new fill or beginning the next stage of construction.

    A. Moisture conditioning of the subgrade by the addition of water or drying of soils may be required prior to densification, depending upon conditions at the time of construction.
    B. Static rolling may be necessary to prevent water from wicking up into the overlying soils if water levels are shallow at the time of construction.
    C. Soils may need to be plowed or disced and dried (or in some cases wetted) in order to adjust the moisture content to suitable levels for compaction.

5. Following densification but prior to new fill placement, the densified subgrade surface should be proofrolled by the contractor under the observation of a representative of the Geotechnical Engineer (S&ME) by making repeated passes with a fully-loaded dump truck or equipment with similar weight and tire pressures. The proofrolling should be conducted only during dry weather. Areas of rutting or pumping soils indicated by the proofroll may require selective undercutting or further stabilization prior to any new fill placement or slab construction, as determined by the Geotechnical Engineer.

8.3 Use of Excavated Soils as Structural Fill (Fill Suitability)

Some of the undocumented fill soils of Stratum I may be suitable for re-use as backfill where they do not contain excessive organics. Most of the sands encountered in Stratum II appear to be generally suitable for re-use as structural fill on the site; however, where soils are excavated from below the groundwater table, they may require extensive drying.

Where the borrowed soils contain less than about 10 percent silt/clay fines content by weight, some of the excess water may drain out of these soils if they are stockpiled for a relatively short period of time prior to placing the material as fill in structural areas. Soils containing more than about 10 percent silt/clay fines are unlikely to dry in a stockpile and will likely have to be worked to reduce their moisture content sufficient to allow proper compaction (usually to within about 2 to 3 percent above optimum).

The silts and clays of Stratum III are expected to be unsuitable for use as borrow.

8.4 Fill Placement and Compaction

Where new fill soils are to be placed, the following recommendations apply:

1. Fill should be comprised of soils free of excessive organic matter or other deleterious materials. Before beginning to place fill, each proposed fill material should be sampled and tested to measure its maximum dry density, optimum moisture content, natural moisture content, and suitability for use as a structural fill material. Fill soils used should meet the following minimum requirements:

    A. Plasticity index of 6 percent or less (ASTM D 4318).
    B. Silt/Clay fines content not greater than 15 percent by weight (ASTM D 1140).
    C. Organic content not greater than 5 percent by weight (ASTM D 2974).
    D. Moisture content within 3 percent, plus or minus, of the modified Proctor (ASTM D 1557) optimum moisture content for compaction (ASTM D2216).
    E. **For pavement areas:** Soaked CBR value (ASTM D1883) of at least 20 percent when recompacted to 95 percent of the modified Proctor ASTM D1557 maximum dry density.

2. Where fill soil is required, structural fill should be compacted throughout to at least 95 percent of the modified Proctor maximum dry density (ASTM D 1557).

    A. Compacted soils should not exhibit pumping or rutting under equipment traffic.

B. Loose lifts of fill should be no more than 12 inches thick prior to compaction, limited to 4 to 6 inches thick if using small, walk-behind compaction equipment. Do not use thickened "bridge" lifts of fill within the limits of the building pad unless approved by the Geotechnical Engineer.
C. Structural fill should extend at least 5 feet from the edge of structures or pavements before either sloping or being allowed to exhibit a lower level of compaction.
D. In non-structural fill areas only, such as in landscaped areas that are located at least 5 feet outside the footprint of pavements and buildings, fill should be compacted to at least 90 percent of the maximum dry density by the Modified Proctor criterion (ASTM D 1557).
E. The moisture content of the fill materials should be controlled to within 3 percent below to 3 percent above the optimum moisture content. In addition to meeting the compaction requirement, fill material should be stable under movement of the construction equipment and should not exhibit rutting or pumping under traffic.

3. Where present, the groundwater level should be maintained at least 2 to 3 feet below any surface to be densified prior to beginning compaction. This is to prevent the compaction operation from drawing water up to the surface and degrading it.
4. Fill placement should be observed by an experienced S&ME soils testing technician working under the guidance of the Geotechnical Engineer.

A. At least one field density test should be performed per each 10,000 square feet for each lift of soil in large area fills in structural areas, with a minimum of 2 tests per lift.
B. At least one field density test should be conducted per each 250 cubic feet of fill placed in confined areas such as isolated undercuts and in trenches or behind walls, with a minimum of 1 test per lift.
C. At least one field density test should be conducted for each 250 linear feet of road alignment backfill, with a minimum of 1 test per lift per section.
D. One-point Proctor verification tests (ASTM D 1557) should be performed on the fill material at a frequency determined by the Geotechnical Engineer as necessary to verify the laboratory Proctor data.

8.5 Shallow Foundations

The soil profile encountered appears generally suitable to support the proposed building with shallow foundations considering static loading conditions and the assumed maximum column and wall loads. The design engineer needs to confirm that the assumed maximum loads are correct; if actual loads are higher, we should be notified and given a reasonable opportunity to reconsider these recommendations, because it could result in changes to the estimated available bearing capacity and static settlement magnitudes.

The following recommendations are provided for the design and construction of shallow foundations at this site for the proposed building:

1. Provided that the recommendations in sections 8.1 through 8.4 of this report are implemented, a net available bearing pressure of up to 2,500 pounds per square foot (psf) may be used for design of individual spread footings and wall footings that are extended to bear upon structural fill compacted as recommended in section 8.4 of this report, or upon properly densified native soils.

2. Lateral capacity of foundations includes a soil lateral pressure and coefficient of friction as described in IBC Section 1806. Foundations will be embedded in material similar to those described as Class 4 in Table 1806.2. Where footings are cast neat against the sides of excavations in natural soils, an allowable bearing pressure of 150 psf per foot depth below natural grade may be used in computations. An allowable coefficient of friction of 0.36, multiplied by the dead load, may be used for computation of sliding resistance. An increase of one-third in the allowable lateral capacity may be considered for load combinations, including wind and earthquake, as permitted by IBC Section 1605.3.2, unless otherwise restricted by design code provisions.
3. Have the Geotechnical Engineer's (S&ME) representative observe and test each cleaned footing excavation prior to concrete placement to observe that the required degree of soil compaction and bearing capacity is present at the foundation bearing surface. This will be evaluated by a combination of Dynamic Cone Penetrometer (DCP) testing, and probing with a small-diameter probe rod.
4. Overexcavation of the immediate foundation support soils in some of the footing excavations may become necessary during the construction process to achieve satisfactory bearing capacity if soft/loose to very loose soil conditions are encountered at bearing grade. The need for overexcavation in the footing excavations should be a field decision made by the Geotechnical Engineer at the time of construction, using DCP test data, in conjunction with shallow hand auger borings, to evaluate the consistency of the bearing soils. Although not expected to be widespread, we anticipate that in cases where foundation bearing soils do need to be undercut and replaced, the depth requiring stabilization will likely be on the order of 1 to 3 feet below the designed bearing grade elevation.

    A. In the event that overexcavation of footings is required, S&ME should be present at the site to observe conditions, confirm that poor soils have been removed, and observe that the overexcavated footings are properly backfilled.
    B. Where overexcavation is performed, foundation bearing grades should be re-established using washed, crushed, coarse gravel (meeting the gradation requirements of SCDOT No. 57 or No. 67 stone) placed in densified 12-inch thick lifts. Each stabilized footing excavation should be observed and tested for suitability to support the design bearing pressure.
    C. For bid purposes, we recommend that you obtain a unit price in advance from your contractor for removal of unsuitable bearing soils and replacement with SCDOT No. 57 or 67 gravel on a per cubic yard basis. You may also wish to include an allowance for this line item in the project budget.

5. It should be anticipated that where footings bear directly on fill, the previously placed fill soils exposed in the bottom of the footings may need to be tamped to increase their density prior to the placement of foundation concrete.
6. Even if smaller dimensions are theoretically allowable from a bearing pressure consideration, the minimum column footing width should be 30 inches and the minimum wall footing width should be 18 inches, to avoid punching shear.
7. Footing concrete should be placed the same day that footings are excavated, to reduce the potential for exposed bearing soils to be softened due to factors such as weathering or water infiltration.
8. The following discussion is provided regarding the estimated magnitude of settlements under static loading.

A. Based on an assumed maximum column load of 150 kips, a uniformly applied area load (slab loading + slab self-weight) of 150 psf, and a 2,500 psf shallow foundation bearing pressure, the estimated total static settlement of an individual spread footing measuring 7 ¾ feet by 7 ¾ feet in plan area will likely be on the order of 1 inch, or less.
B. Based on an assumed wall load of 3 kips per linear foot, a uniformly applied area load (slab loading + slab self-weight) of 150 psf, and a 2,500 psf shallow foundation bearing pressure, the estimated static post-construction settlement of an individual wall strip footing measuring 1 ½ feet in width will likely be on the order of 1 inch, or less.
C. Differential settlements between adjacent, similarly loaded walls and columns are typically on the order of 50 percent of the total post-construction settlement value under static loading, or in this case, about 1/2 inch.

8.6 Grade Slab Support and Construction

The following recommendations are given for the support and construction of soil-supported grade slabs:

1. Soils similar to those penetrated by the borings should provide adequate support to proposed soil-supported grade slabs, assuming preparation and compaction of the subgrade as recommended above. Soil-supported thin slabs on grade may be designed using a modulus of subgrade reaction (k) of 225 pci provided that the subgrade is prepared as recommended in this report.
2. Structural design should incorporate installation of a vapor barrier prior to placing concrete for grade slab systems, to limit moisture-infiltration into finished spaces, where appropriate.
3. Below the floor slab place a layer of at least 4 inches of compacted granular materials to provide a capillary break between the silty sand subgrade and the floor slab in finished spaces.

    A. Granular materials used as the underslab layer may consist of clean sandy soils meeting USCS Classification SP or SW and having a silt-clay fines content of 5 percent or less by weight, or, a crushed, well-graded gravel blend meeting the requirements of Macadam Graded Aggregate Base Course (GABC) as described in Section 305 of the South Carolina Department of Transportation (SCDOT) Standard Specifications for Highway Construction, 2007 edition, or an open-graded, manufactured washed gravel meeting the gradation requirements of SCDOT No. 57 or No. 67 stone.
    B. If sand or washed gravel is used as the underslab layer, then the contractor should plan on using a pump truck to place the floor slab concrete since these materials are cohesionless and are difficult to drive vehicles on. If GABC is used, then either a pump truck or direct discharge from concrete batch trucks may be appropriate depending upon the circumstances.
    C. If sand or GABC is used, this underslab layer should be compacted to at least 95 percent of the modified Proctor maximum dry density (ASTM D 1557) as determined by field density testing.

4. Have the Geotechnical Engineer observe a proofroll of all slab subgrades prior to concrete placement. Softened soils may need to be undercut or stabilized before concrete placement.

8.7 Lateral Earth Pressures for Shallow Buried Structures

The equivalent fluid pressures given below should be used to design near-surface soil retaining structures in the upper 5 feet of the native soil profile or within fill zones, such as loading dock walls. Under static conditions, the

equivalent at-rest fluid pressure should be used to design soil-retaining structures which are fixed at the top against rotation.

Walls which will not be fixed at the top prior to application of the lateral pressures should also be designed to withstand the active earth pressures as a cantilevered wall. The values given in the following table assumes placement and compaction of backfill around these structures in accordance with the compaction recommendations given in Section 8.4 of this report.

These values assume level backfill generally classified as sandy soils (SP, SW, SP-SM) or gravel (GP, GW) according to the Unified Soil Classification system. These assumptions were made based upon the use of imported sands or clean gravels as the backfill material behind any earth-retaining walls.

Table 8-1: Equivalent Fluid Lateral Earth Pressures

Support Condition	Angle of Internal Friction (φ') (degrees)	Soil Moist Unit Weight (γ) (lbs./cu.ft.)	DRAINED CONDITION	
			Earth Pressure Coefficient (Static Loading) (lbs./cu.ft.)	Earth Pressure Coefficient (Seismic) PGA = 0.245g (lbs./cu.ft.)
Active (K_a)	30	120	0.33	0.40
At-Rest (K_o)	30	120	0.50	0.60
Passive (K_p)	30	120	3.0	2.81

1. The values in this table represent a fully-drained soil condition at or near the optimum moisture content. Where backfill soils are not fully drained, the design of the wall must consider lateral soil pressures due to hydrostatic forces below the water level, and the submerged soil unit weight.
2. A coefficient of sliding friction (tan Φ) of 0.36 may be used in computation of the lateral sliding resistance.

We have not been provided details regarding the locations or height of retaining walls. Note that any wall which is backfilled prior to being braced internally by framing must, in addition to being designed as a fully braced wall using the at-rest earth pressure, also be designed to resist the lateral earth pressure for the active case as a fully cantilevered wall.

Note that inorganic plastic clay (CL/CH) soils should not be used as backfill immediately behind retaining walls, because these soils are not freely draining.

Footings located near proposed retaining walls may impose surcharge loads in addition to the earth pressures tabulated above. Alternatively, you may elect to extend footings to bear entirely below a line that is projected upward at a 45-degree angle from the inner toe of the wall to avoid placing surcharge pressures on the wall due to footing loads.

Compact the backfill directly behind walls with light, hand-held compactors. Heavy compactors and grading equipment should not be allowed to operate within 5 feet of the walls during backfilling to avoid developing

excessive temporary or long-term lateral soil pressures. The soil backfill placed behind retaining walls must be compacted to at least 95 percent of the soil's modified Proctor maximum dry density. We caution that operating compaction equipment directly behind the retaining structures can create lateral earth pressures far in excess of those recommended for design. Therefore, bracing of the walls may be needed during backfilling operations.

Provide positive gravity drainage of the backfill using a permanent toe drain to limit buildup of hydrostatic pressures in the backfill. Gravity drainage may consist of a minimum two-foot-wide blanket of clean crushed stone or washed sand, separated from the backfill by a properly graded filter or approved filter fabric, or a specially designed geotextile material such as Enka-drain, or equivalent. Vertical drains should be tied into a permanent "toe" drain installed at the base of the wall. Where gravity drainage of retaining walls is not feasible, design walls to resist hydrostatic forces in addition to lateral earth pressure.

8.8 Pavement Section Design and Construction

We understand that new site pavements will consist of flexible pavements using Hot-Mixed Asphalt and rigid Portland cement concrete. Based upon the assumption that the pavement support soils consist of properly densified native soils and sandy fill soils meeting the material requirements described in section 8.4, and considering our laboratory testing results on the adjacent site, we estimate that an average combined California Bearing Ratio (CBR) value of at least 20 percent will be available for pavement support. This results in a resilient modulus of at least 17,380 psi available for flexible pavement design. If materials having lesser subgrade support values are to be considered for use, the pavement design should be reevaluated and required pavement thickness may need to be increased as a result.

Flexible pavement design assumes an initial serviceability of 4.2 and a terminal serviceability index of 2.0, and a reliability factor of 95 percent. ESALs per axle were estimated using data provided in AASHTO literature. Assuming that only SCDOT approved source materials will be used in flexible pavement section construction, we used a structural layer coefficient of 0.44 for the HMA layers and a coefficient of 0.18 for the GABC. A sub-base drainage factor of 0.9 was assigned, based upon the assumption that the sub-base soils will likely consist of imported sand to slightly silty sand soils.

Rigid pavement design assumes an initial serviceability of 4.5 and a terminal serviceability index of 2.5, and a reliability factor of 80 percent. Assuming that the concrete will likely be unreinforced, we used an average load transfer coefficient of 3.8. We also assumed a minimum 28-day design compressive strength of at least 4,000 psi for the PCC.

Traffic frequency and loading data was not provided prior to our issuing this report; therefore, we estimated that the site pavements at this site may experience a lifetime traffic demand of roughly 100,000 ESALs. If the actual traffic loading is greater that the assumed, then thicker pavement sections may be required. Based on the estimated demand, we estimate that pavement sections shown in Table 8-2 below should be sufficient to carry the anticipated traffic loading with reasonable factors of safety.

Table 8-2: Recommended Pavement Sections[a]

Pavement Type	Theoretical Available Traffic Capacity (ESALs)	HMA Surface Course Type C (inches)	4,000 psi Unreinforced Rigid PCC (inches)	SCDOT Graded Aggregate Base Course [GABC] (inches)
Standard-Duty Flexible HMA (No Trucks)	118,000	2.0[b]	---	6.0
Standard-Duty Rigid PCC (with Truck traffic)	285,000	---	6.0	6.0

(a)Single-stage construction and soil compaction as recommended is assumed; S&ME, Inc. must observe pavement subgrade preparations and pavement installation operations.

(b)It is recommended to increase the asphalt layer thickness by at least 1 additional inch along trash truck routes, if any.

S&ME did not factor the traffic by direction or by lane. Nor did we make any reduction in the ESAL loading to account for two or more points of access or egress.

8.8.1 General Recommendations for Pavement Areas

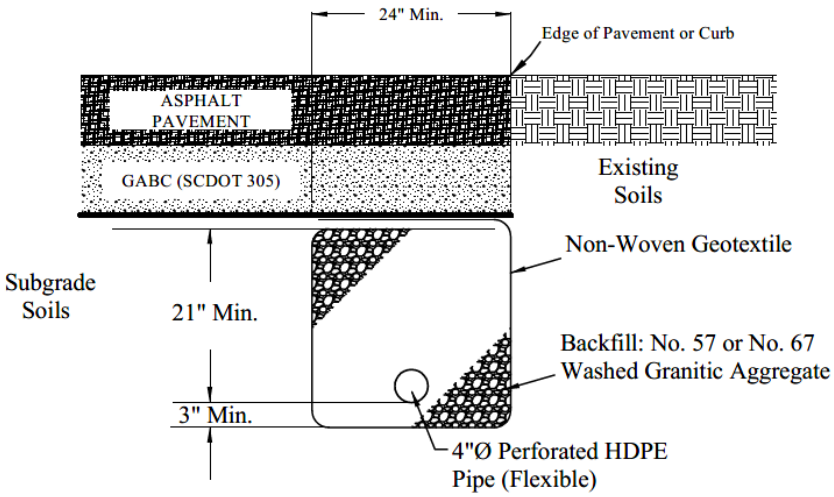
1. At least one laboratory California Bearing Ratio (CBR) test should be performed upon a representative soil sample of each soil type which is planned to be used as pavement subgrade material. This is to establish the relationship between relative compaction and CBR for the soil in question, and to confirm that the obtained CBR value at the required level of compaction is equal to or greater than the CBR value utilized during design of the pavement section, which was 20 percent.
2. All fill placed in pavement areas should be compacted as recommended in Section 8.4 "Fill Placement and Compaction".

8.8.2 Permanent Underdrains

Control of subsurface water will be very important to continued satisfactory performance of pavements over the long term. Where possible, road alignments should be crowned and ditched to promote positive drainage from the road surface and subgrade. Where crowning and ditching is not feasible, site drainage plans should result in water levels being maintained at least 2 feet below the pavement surface.

We recommend that the civil engineer consider incorporating permanent gravel-filled, fabric-wrapped underdrains into the design of the pavement section to allow water that infiltrates the subsurface to escape into the storm drain systems. This is especially critical if a "reverse crown" design is used in the parking lots, where the natural flow of water and runoff is towards the center of the pavement areas. Do not fill any landscaped islands in the parking lots with clayey or silty (impermeable) spoils that may impede the movement of water into the drainage systems. See Figure 8-1 below for an example underdrain typical detail that could be considered.

Figure 8-1: Typical Underdrain Detail



8.8.3 Base Course and Pavement Section Construction

The following recommendations are provided for base course and pavement section construction:

1. Prior to placement of base course stone, all exposed pavement subgrades should be methodically proofrolled by the contractor under the observation of a representative of the Geotechnical Engineer (S&ME), and any identified unstable areas should be repaired. Pavement subgrades should not exhibit rutting or pumping under the proofroll load. Rutting or pumping areas shall be undercut and replaced and/or stabilized as directed by the engineer.
2. Crushed stone aggregate base material used in pavement section construction should consist of graded aggregate base course (GABC) as defined by Section 305 of the South Carolina Department of Transportation Standard Specifications for Highway Construction (2007). The base course should be compacted to at least 100 percent of the modified Proctor maximum dry density (SC-T-140).

    A. The GABC should consist of either Macadam or Marine Limestone base course as defined in Section 305 of the above-referenced specification.
    B. Do not allow the substitution of Coquina shell type base course for the specified GABC material.
    C. It is not recommended to allow the substitution of "commercial base" (e.g. non-SCDOT compliant) base course materials.

3. After placement of base course stone, the surface should be methodically proofrolled at final base grade elevation by the contractor under the observation of a representative of the Geotechnical Engineer (S&ME), and any identified unstable areas should be repaired. The base course material should not exhibit pumping or rutting under equipment traffic. Rutting or pumping areas shall be undercut and replaced and/or stabilized as directed by the engineer.

4. Heavy compaction equipment is likely to be required in order to achieve the required base course compaction, and the moisture content of the material will likely need to be maintained near optimum moisture content in order to facilitate proper compaction.
5. Construct the surface and intermediate course HMA in accordance with the specifications of Sections 401, 402, and 403 of the South Carolina Department of Transportation Standard Specifications for Highway Construction (2007 edition).
6. Sufficient testing should be performed during flexible pavement installation to confirm that the required thickness, density, and quality requirements of the pavement specifications are followed.
7. Experience indicates that a thin surface overlay of asphalt pavement may be required in about 10 years due to normal wear and weathering of the surface. Such wear is typically visible in several forms of pavement distress, such as aggregate exposure and polishing, aggregate stripping, asphalt bleeding, and various types of cracking. There are means to methodically estimate the remaining pavement life based on a systematic statistical evaluation of pavement distress density and mode of failure. We recommend the pavement be evaluated in about 7 years to assess the pavement condition and remaining life.
8. For rigid pavements, we recommend air-entrained ASTM C 94 joint reinforced Portland cement concrete that will achieve a minimum compressive strength of at least 4,000 psi at 28 days after placement, as determined by ASTM C 39. We also recommend that the pavement concrete be constructed in a manner which at least meets the minimum standards recommended by the American Concrete Institute (ACI).
9. We recommend that at least 1 set of 5 cylinder specimens be cast by S&ME per every 50 cubic yards of concrete placed or at least once per placement event in order to measure achievement of the design compressive strength. We also recommend that S&ME be present on site to observe concrete placement.

9.0 Limitations of Report

This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to this project. The conclusions and recommendations in this report are based on the applicable standards of our practice in this geographic area at the time this report was prepared. No other warranty, expressed or implied, is made.

The analyses and recommendations submitted herein are based, in part, upon the data obtained from the subsurface exploration. The nature and extent of variations across the site may not become evident until construction. If variations appear evident, then we should be given a reasonable opportunity to re-evaluate the recommendations of this report. In the event that any changes in the nature, design, or location of the structures are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions modified or confirmed in writing by the submitting engineers.

Assessment of site environmental conditions; sampling of soils, ground water or other materials for environmental contaminants; identification of jurisdictional wetlands, rare or endangered species, geological hazards or potential air quality and noise impacts were beyond the scope of this geotechnical exploration.

Information regarding auxiliary construction items including but not limited to: retaining walls, loading docks, curbing, street lights, signage, utilities, fountains, flagpoles, crane support pads, etc. was not provided by the client

and therefore has not been addressed as part of the scope of this report. If additional foundation design or construction recommendations are needed with regard to any such items, please contact us for more information.

Unless specifically noted otherwise, our field exploration program did not include an assessment of regulatory compliance, environmental conditions or pollutants or presence of any biological materials (mold, fungi, bacteria). If there is a concern about these items, other studies should be performed. S&ME can provide a proposal and perform these services if requested.

S&ME should be retained to review the final plans and specifications to confirm that earthwork, foundation, and other recommendations are properly interpreted and implemented. The recommendations in this report are contingent on S&ME's review of final plans and specifications followed by our observation and testing of earthwork and foundation construction activities.

Appendices

Appendix I – Figures



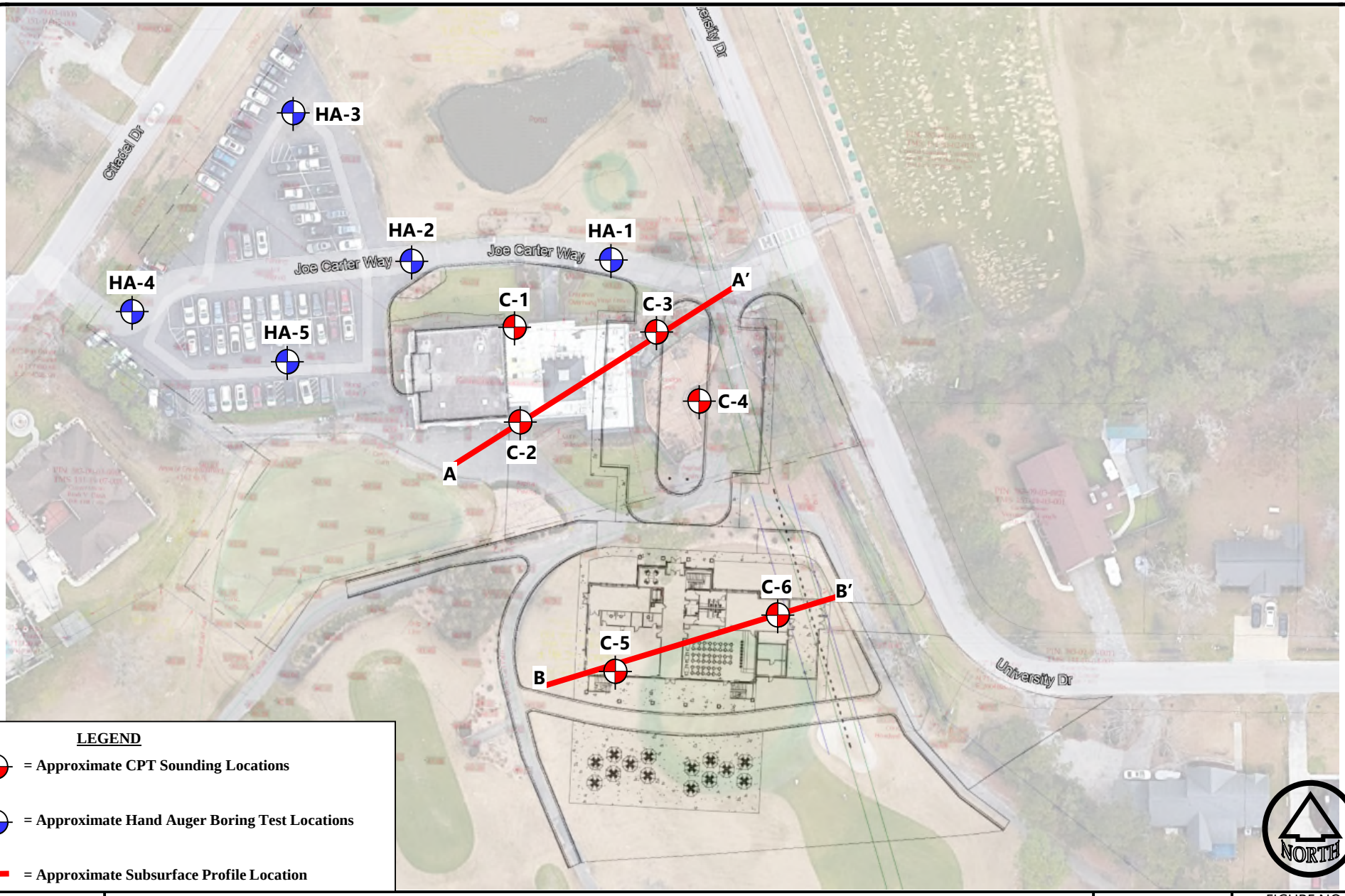
REFERENCE:
Image Courtesy of Google Earth

NORTH

Site Vicinity Map

CCU PGA Golf Management Academic Learning Lab
Conway, South Carolina

SCALE:	FIGURE NO.
Not to Scale	1
DATE: 7/31/23	
PROJECT NUMBER 22630133A	



LEGEND

= Approximate CPT Sounding Locations

= Approximate Hand Auger Boring Test Locations

= Approximate Subsurface Profile Location

Test Location Sketch

CCU PGA Golf Management Program Academic Learning Lab
Conway, South Carolina

SCALE:	NOT TO SCLAE
DATE:	8/2/2023
PROPOSAL NUMBER	22630133A
FIGURE NO.	2

A

A'

C-2
9/6/2022
ELEV.0

C-3
9/2/2022
ELEV.0

SLEEVE STRESS (TSF) 10 8 6 4 2

TIP RESIST (TSF) 0 100 200 300 400 500

Topsoil

Stratum I: Undocumented Fill

Stratum II: Upper Coastal Plain Sands

Stratum III: Intermediate Soft to Firm Clays and Silts

Stratum IV: Interbedded Sands, Silts, and Clays

--- Loose Sand Lense

DEPTH (feet)

0 -5 -10 -15 -20 -25 -30 -35 -40 -45

BT @ 32.04

BT @ 42.73

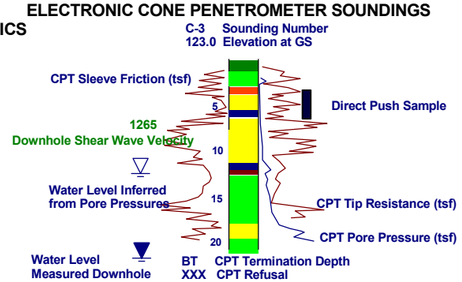
0 10 20 30 40 PORE PRESSURE (TSF)

0 20 40 60 80 100 120 140 160

ELECTRONIC CONE PENETROMETER SOUNDINGS

CPT/DMT MATERIAL GRAPHICS

- Sensitive Fine Grained Soils
- Organic Soils, Peats
- Clay to Silty Clay
- Clayey Silt to Silty Clay
- Silty Sand to Sandy Silt
- Clean Sand to Silty Sand
- Gravelly Sand to Sand
- OC Sand to Clayey Sand
- OC Fine Grained Soils



The depicted stratigraphy is shown for illustrative purposes only and is not warranted. Separations between different strata may be gradual and likely vary considerably from those shown. Profiles between nearby borings have been estimated using reasonable engineering care and judgment. The actual subsurface conditions will vary between boring locations.

SUBSURFACE PROFILE

FIGURE: 3

PROJECT: CCU PGA Golf Management Program Academic Learning Lab

LOCATION: Conway, South Carolina

JOB NO: 22630133

DATE: 9/27/22

B

B'

C-5
7/24/2023
ELEV.0

C-6
7/24/2023
ELEV.0

SLEEVE STRESS (TSF) 10 8 6 4 2 2

TIP RESIST (TSF) 100 200 300 400 500

EXISTING GROUND SURFACE

STRATUM I: UNDOCUMENTED FILL

STRATUM II: UPPER COASTAL PLAIN SANDS

STRATUM III: INTERMEDIATE SOFT TO FIRM CLAYS AND SILTS

STRATUM IV: INTERBEDDED SANDS, SILTS, AND CLAYS

DEPTH (feet)

0 -5 -10 -15 -20 -25 -30 -35 -40

0 5 10 15 20 25 30 35

0 10 20 30 40

XXX @ 37.86 PORE PRESSURE (TSF)

0 10 20 30 40

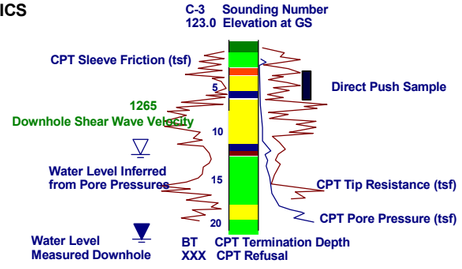
XXX @ 32.22 PORE PRESSURE (TSF)

0 10 20 30 40 60 70 80 90 100 110 120

ELECTRONIC CONE PENETROMETER SOUNDINGS

CPT/DMT MATERIAL GRAPHICS

- Sensitive Fine Grained Soils
- Organic Soils, Peats
- Clay to Silty Clay
- Clayey Silt to Silty Clay
- Silty Sand to Sandy Silt
- Clean Sand to Silty Sand
- Gravelly Sand to Sand
- OC Sand to Clayey Sand
- OC Fine Grained Soils



The depicted stratigraphy is shown for illustrative purposes only and is not warranted. Separations between different strata may be gradual and likely vary considerably from those shown. Profiles between nearby borings have been estimated using reasonable engineering care and judgment. The actual subsurface conditions will vary between boring locations.

SUBSURFACE PROFILE

PROJECT: CCU PGA Golf Management Program
Academic Learning Lab

FIGURE: 3A

LOCATION: Conway, South Carolina

JOB NO: 22630133A

DATE: 7/31/23

Shear Wave Velocity Calculations

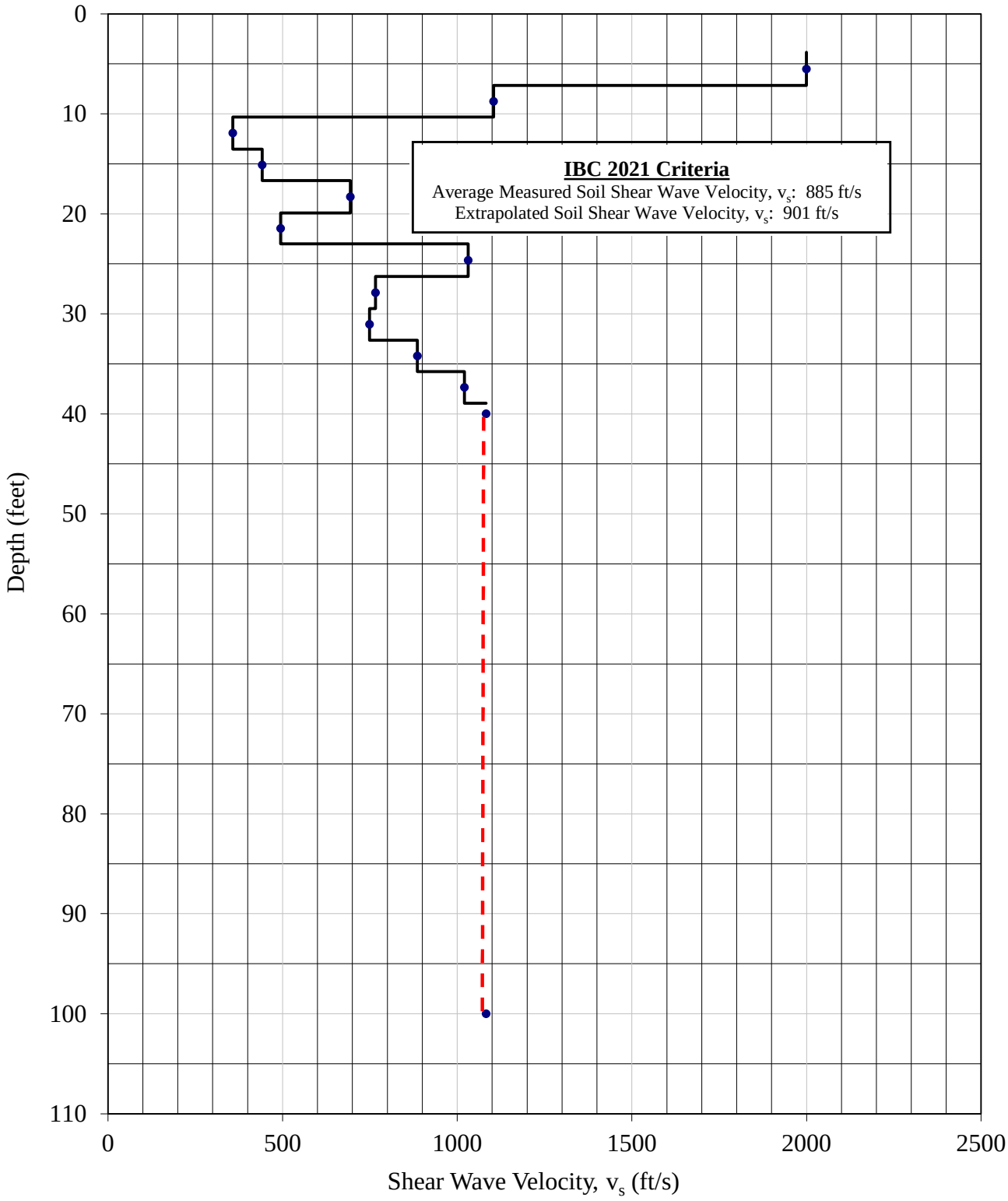
Figure 4

CCU PGA Golf Management Academic Learning Lab

Conway, Sotuh Carolina

Sounding ID: **C-03** Project Number: **22630133**

Date: 09/02/22



* Site Class based on 2021 International Building Code - *Table 1613.5.2 - SITE CLASS DEFINITIONS*

Appendix II – Exploration Procedures and Data

♦ Summary of Exploration Procedures

The American Society for Testing and Materials (ASTM) publishes standard methods to explore soil, rock and ground water conditions in Practice D-420-18, "*Standard Guide for Site Characterization for Engineering Design and Construction Purposes.*" The boring and sampling plan must consider the geologic or topographic setting. It must consider the proposed construction. It must also allow for the background, training, and experience of the geotechnical engineer. While the scope and extent of the exploration may vary with the objectives of the client, each exploration includes the following key tasks:

- Reconnaissance of the Project Area
- Preparation of Exploration Plan
- Layout and Access to Field Sampling Locations
- Field Sampling and Testing of Earth Materials
- Laboratory Evaluation of Recovered Field Samples
- Evaluation of Subsurface Conditions

The standard methods do not apply to all conditions or to every site. Nor do they replace education and experience, which together make up engineering judgment. Finally, ASTM D 420 does not apply to environmental investigations.

♦ Reconnaissance of the Project Area

We walked over the site to note land use, topography, ground cover, and surface drainage. We observed general access to proposed sampling points and noted any existing structures.

Checks for Hazardous Conditions - State law requires that we notify the South Carolina (SC 811) before we drill or excavate at any site. SC 811 is operated by the major water, sewer, electrical, telephone, CATV, and natural gas suppliers of South Carolina. SC 811 forwarded our location request to the participating utilities. Location crews then marked buried lines with colored flags within 72 hours. They did not mark utility lines beyond junction boxes or meters. We checked proposed sampling points for conflicts with marked utilities, overhead power lines, tree limbs, or man-made structures during the site walkover.

♦ Boring and Sampling

Electronic Cone Penetrometer (CPT) Soundings

CPT soundings consist of a conical pointed penetrometer which is hydraulically pushed into the soil at a slow, measured rate. Procedures for measurement of the tip resistance and side friction resistance to push generally follow those described by ASTM D-5778, "*Standard Test Method for Performing Electronic Friction Cone and Piezocone Penetration Testing of Soils*."

A penetrometer with a conical tip having a 60 degree apex angle and a cone base area of 10 cm^2 was advanced into the soil at a constant rate of 20 mm/s. The force on the conical point required to penetrate the soil was measured electronically every 50 mm penetration to obtain the *cone resistance* q_c. A friction sleeve is present on the penetrometer immediately behind the cone tip. The force exerted on the sleeve was measured electronically at a minimum of every 50 mm penetration and divided by the surface area of the sleeve to obtain the *friction*

sleeve resistance value f_s A pore pressure element mounted immediately behind the cone tip was used to measure the pore pressure induced during advancement of the cone into the soil.

CPT Soil Stratification

Using ASTM D-5778 soil samples are not obtained. Soil classification was made on the basis of comparison of the tip resistance, sleeve resistance and pore pressure values to values measured at other locations in known soil types, using experience with similar soils and exercising engineering judgment.

Plots of normalized tip resistance versus friction ratio and normalized tip resistance versus penetration pore pressure were used to determine soil classification (Soil Behavior Type, SBT) as a function of depth using empirical charts developed by P.K. Robertson (1990). The friction ratio soil classification is determined from the chart in the appendix using the normalized corrected tip stress and the normalized corrected tip stress and the normalized friction ratio.

At some depths, the CPT data fell outside of the range of the classification chart. When this occurred, no data was plotted and a break was shown in the classification profile. This occasionally occurred at the top of a penetration as the effective vertical stress is very small and commonly produced normalized tip resistances greater than 1000.

To provide a simplified soil stratigraphy for general interpretation and for comparison to standard boring logs, a statistical layering and classification system was applied the field classification values. Layer thicknesses were determined based on the variability of the soil classification profile, based upon changes in the standard deviation of the SBT classification number with depth. The average SBT number was determined for each successive 6-inch layer, beginning at the surface. Whenever an additional 6-inch increment deviated from the previous increment, a new layer was started, otherwise, this material was added to the layer above and the next 6-inch section evaluated. The soil behavior type for the layer was determined by the mean value for the complete layer.

Downhole Shear Wave Velocity Test

Shear wave velocity measurements were performed using a cone penetrometer equipped with geophones, or a seismic cone penetrometer (SCPT). The seismic cone penetrometer measures the travel times of surface generated vibrations to geophones mounted on the penetrometer at various incremental depths in the sounding. At a given depth, the travel time of the first arrival is measured and corrected for the horizontal offset of the source at the surface from the sounding. Interval velocities are calculated by dividing the difference in travel times by the vertical distance between successive measurement depths. Measurements were made at 1 meter intervals – the length of commonly available CPT extension rods – unless otherwise noted.

Refusal to CPT Push

Refusal to the cone penetrometer equipment occurred when the reaction weight of the CPT rig was exceeded by the thrust required to push the conical tip further into the ground. At that point the rig tended to lift off the ground. Refusal may have resulted from encountering hard cemented or indurated soils, soft weathered rock, coarse gravel, cobbles or boulders, thin rock seams, or the upper surface of sound continuous rock. Where fills are present, refusal to the CPT rig may also have resulted from encountering buried debris, building materials, or objects.

Hand Auger Borings

Auger borings were advanced using hand-operated augers. The soils encountered were identified in the field by cuttings brought to the surface. Representative samples of the cuttings were placed in plastic bags and transported to the laboratory. Soil consistency was qualitatively estimated by the relative difficulty of advancing the augers. Penetration resistance was not measured in the hand auger borings; density characterization was based upon the relative difficulty of advancing the auger.

Standard Dynamic Cone Penetrometer (DCP)

At selected intervals, the augers were withdrawn and soil consistency measured with a dynamic cone penetrometer. The conical point of the penetrometer was first seated 1-3/4 inches to penetrate any loose cuttings in the boring, then driven two additional 1-3/4 inch increments by a 15 pound hammer falling 20 inches. The number of hammer blows required to achieve this penetration was recorded. When properly evaluated by qualified professional staff, the blow count is an index to the soil strength and ability to support foundations.

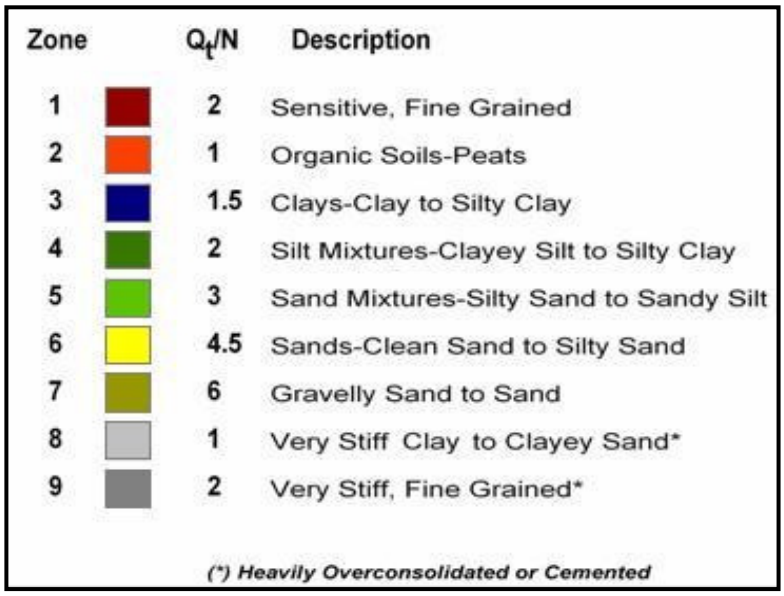
Water Level Measurement

Subsurface water levels in the boreholes were measured during the onsite exploration by measuring depths from the existing grade to the current water level using a tape at time of drilling. Within the CPT soundings, subsurface water levels were interpreted based on pore water pressure.

Backfilling of Borings

Once subsurface water levels were obtained, boring spoils were backfilled into the open bore holes. Hand auger bore holes were backfilled to the existing ground surface. CPT soundings were not back filled due to their small size.

CPT Soil Classification Legend



Robertson's Soil Behavior Type (SBT), 1990			
Group #	**Description**	**Ic**	
		Min	**Max**
1	Sensitive, fine grained	N/A	
2	Organic soils - peats	3.60	N/A
3	Clays - silty clay to clay	2.95	3.60
4	Silt mixtures - clayey silt to silty clay	2.60	2.95
5	Sand mixtures - silty sand to sandy silt	2.05	2.60
6	Sands - clean sand to silty sand	1.31	2.05
7	Gravelly sand to dense sand	N/A	1.31
8	Very stiff sand to clayey sand (High OCR or cemented)	N/A	
9	Very stiff, fine grained (High OCR or cemented)	N/A	

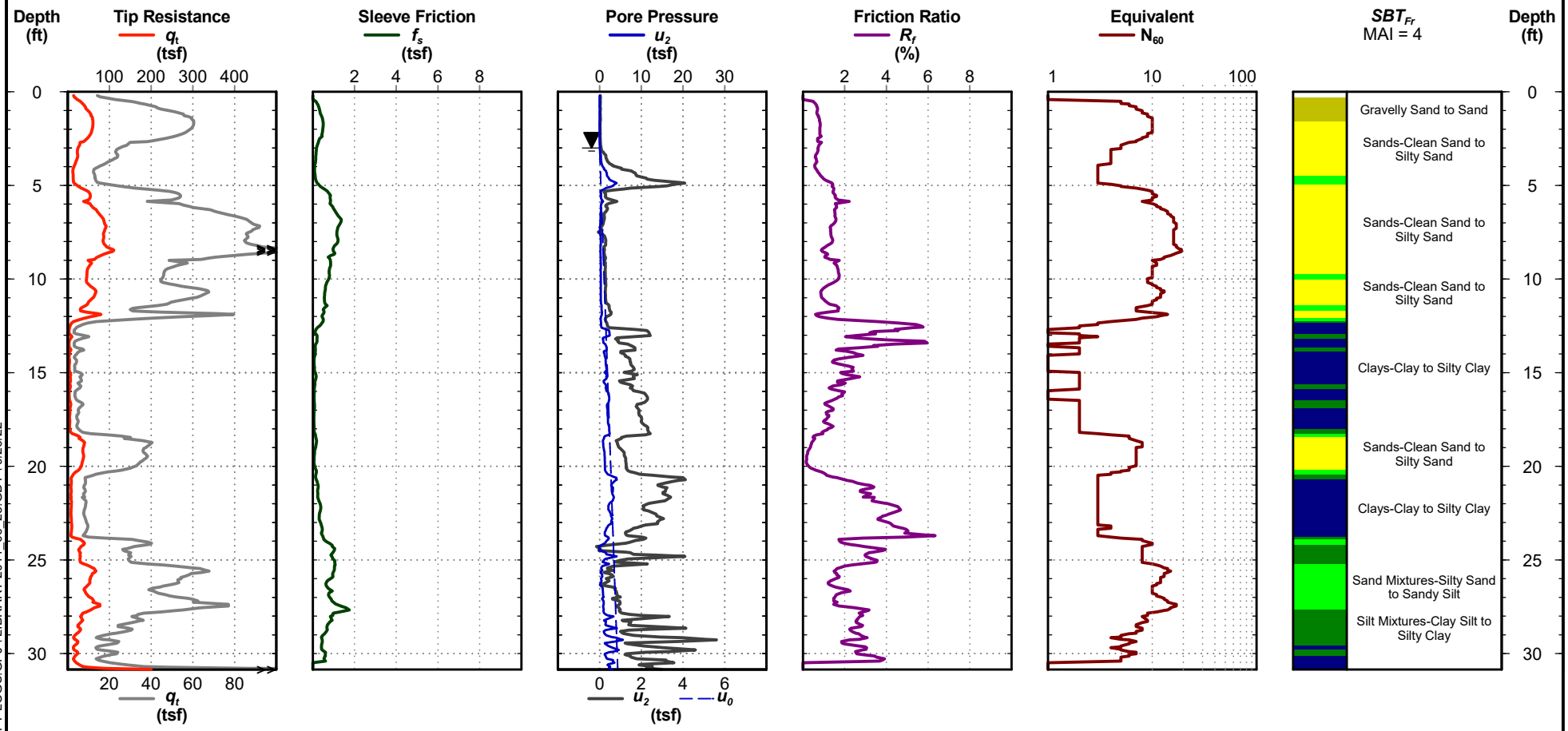
Soil behavior type is based on empirical data and may not be representative of soil classification based on plasticity and grain size distribution.

Relative Density and Consistency Table			
SANDS		SILTS and CLAYS	
Cone Tip Stress, qt (tsf)	Relative Density	Cone Tip Stress, qt (tsf)	Consistency
Less than 20	Very Loose	Less than 5	Very Soft
20 - 40	Loose	5 - 15	Soft to Firm
40 - 120	Medium Dense	15 - 30	Stiff
120 - 200	Dense	30 - 60	Very Stiff
Greater than 200	Very Dense	Greater than 60	Hard

CCU PGA Golf Management Program Academic Learning Lab
Conway, South Carolina
S&ME Project No: 22630133

Sounding ID: C-1

Date: Sep. 6, 2022
Estimated Water Depth: 3 ft
Rig/Operator: MWright | TWhitehead
Total Depth: 30.9 ft
Termination Criteria: Maximum Reaction Force
Cone Size: 1.75



Cone Penetration Test

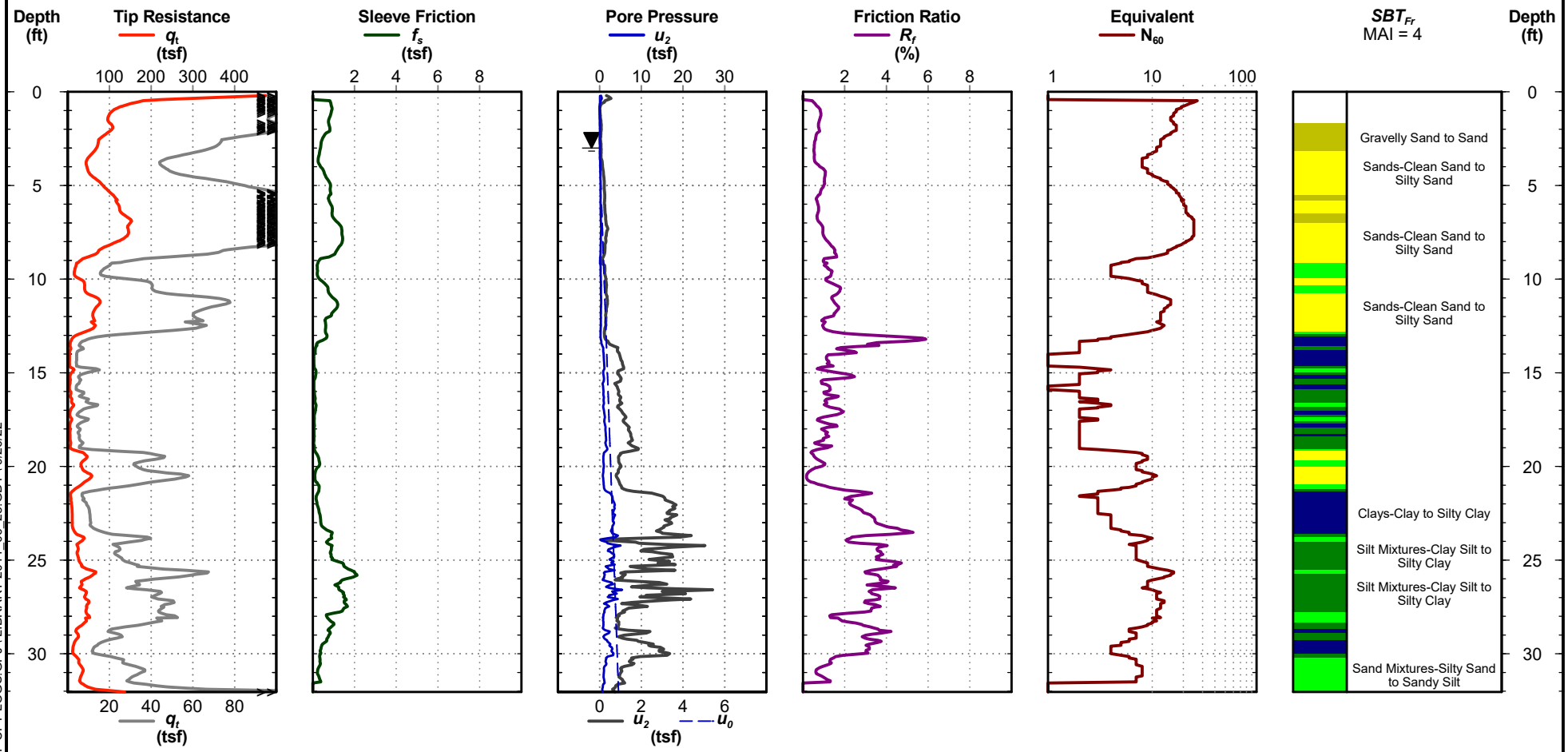
Electronic Filename: C-01.DAT

CPT REPORT - DYNAMIC \ CCU GOLF CPT LOGS.GPJ \ LIBRARY 2011_06_28.GDT \ 9/26/22

CCU PGA Golf Management Program Academic Learning Lab
Conway, South Carolina
S&ME Project No: 22630133

Sounding ID: C-2

Date:	Sep. 6, 2022	**Total Depth:**	32.0 ft
Estimated Water Depth:	3 ft	**Termination Criteria:**	Maximum Reaction Force
Rig/Operator:	MWright | TWhitehead	**Cone Size:**	1.75



Cone Penetration Test

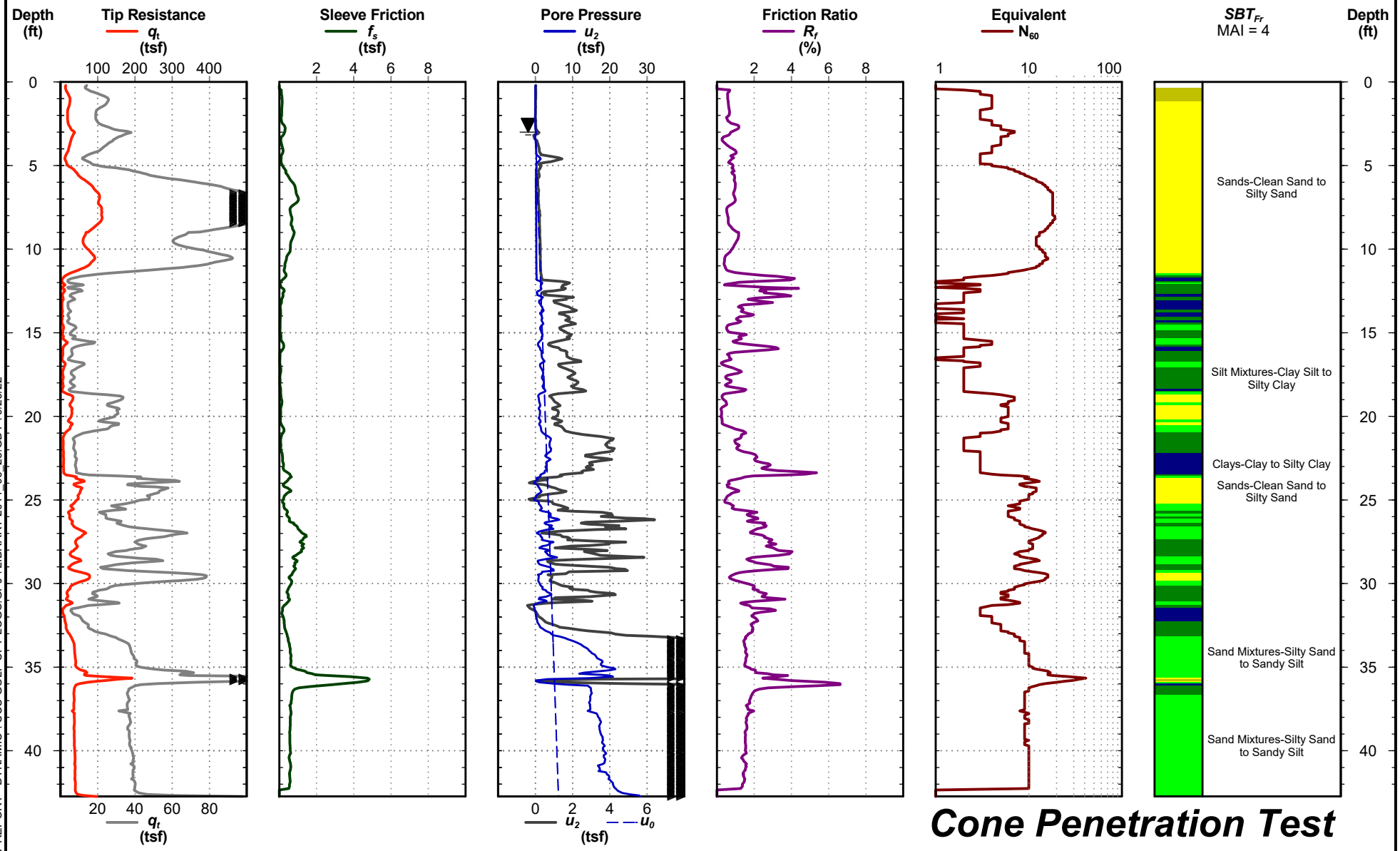
Electronic Filename: C-02.DAT

CPT REPORT - DYNAMIC \ CCU GOLF CPT LOGS.GPJ \ LIBRARY 2011_06_28.GDT \ 9/26/22

Sounding ID: C-3

CCU PGA Golf Management Program Academic Learning Lab
Conway, South Carolina
S&ME Project No: 22630133

Date:	Sep. 2, 2022	**Total Depth:**	42.7 ft
Estimated Water Depth:	3 ft	**Termination Criteria:**	Maximum Reaction Force
Rig/Operator:	MWright | TWhitehead	**Cone Size:**	1.75



Cone Penetration Test

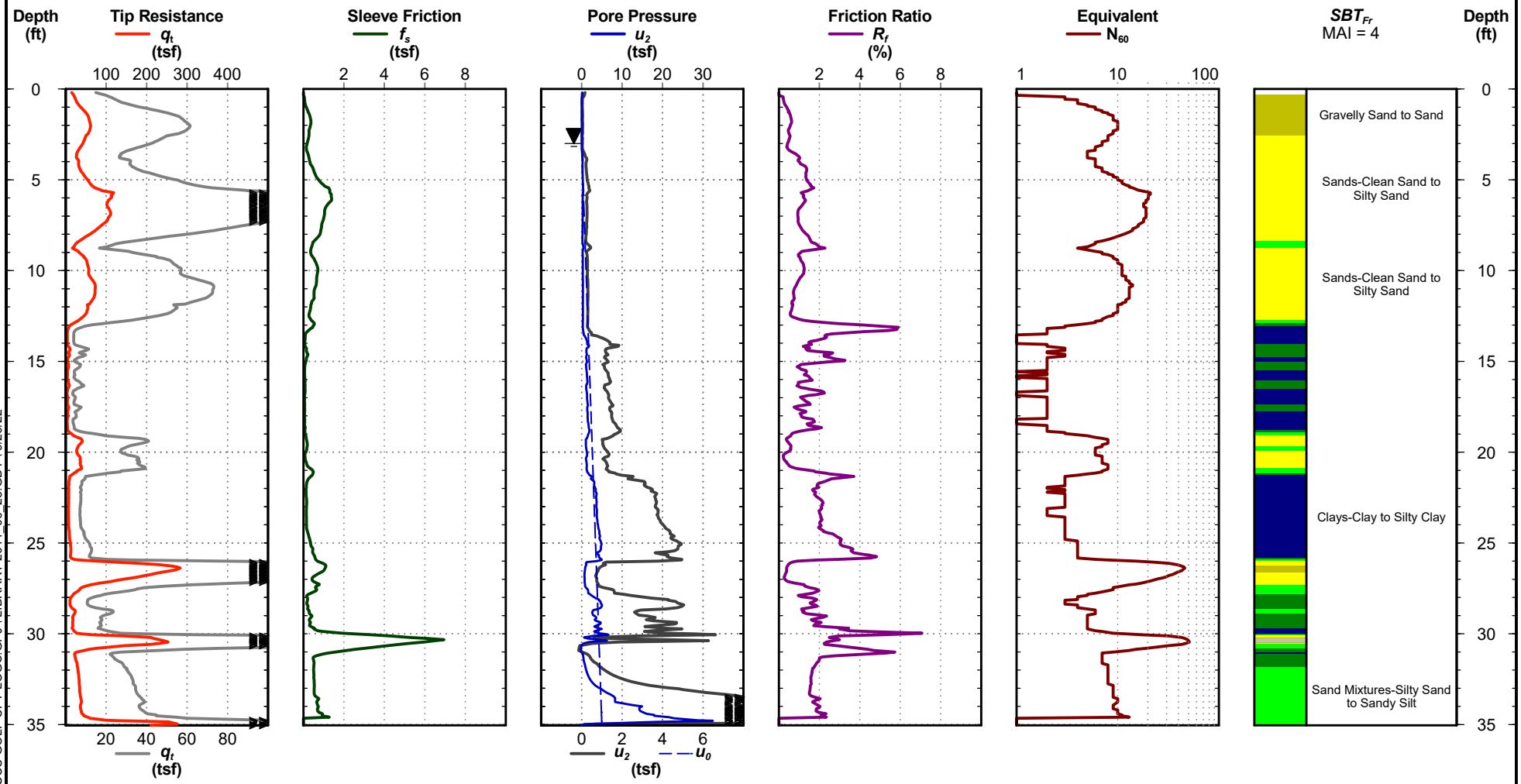
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CPT REPORT - DYNAMIC \ CCU GOLF CPT LOGS.GPJ \ LIBRARY 2011_06_28.GDT \ 9/26/22

CCU PGA Golf Management Program Academic Learning Lab
Conway, South Carolina
S&ME Project No: 22630133

Sounding ID: C-4

Date: Sep. 6, 2022
Estimated Water Depth: 3 ft
Rig/Operator: MWright | TWhitehead
Total Depth: 35.0 ft
Termination Criteria: Target Depth
Cone Size: 1.75



Cone Penetration Test

Electronic Filename: C-04.DAT

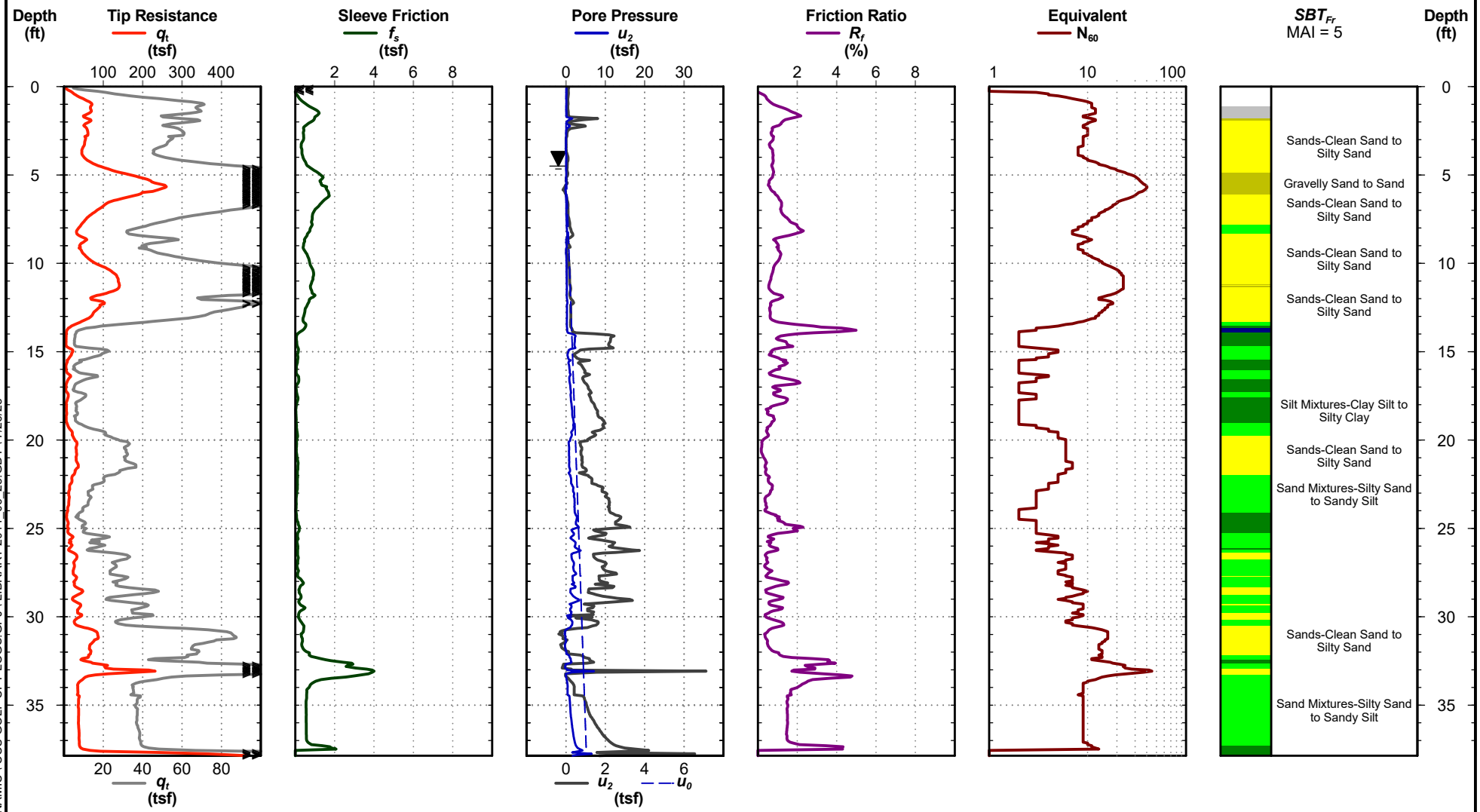
CPT REPORT - DYNAMIC \ CCU GOLF CPT LOGS.GPJ \ LIBRARY 2011_06_28.GDT \ 9/26/22

Sounding ID: C-5

CCU PGA Golf Management Program Academic Learning Lab
Conway, South Carolina
S&ME Project No: 22630133A

Date: Jul. 24, 2023
Estimated Water Depth: 4.5 ft
Rig/Operator: Marooka/D Coffee

Total Depth: 37.9 ft
Termination Criteria: Maximum Reaction Force
Cone Size: 1.75



Cone Penetration Test

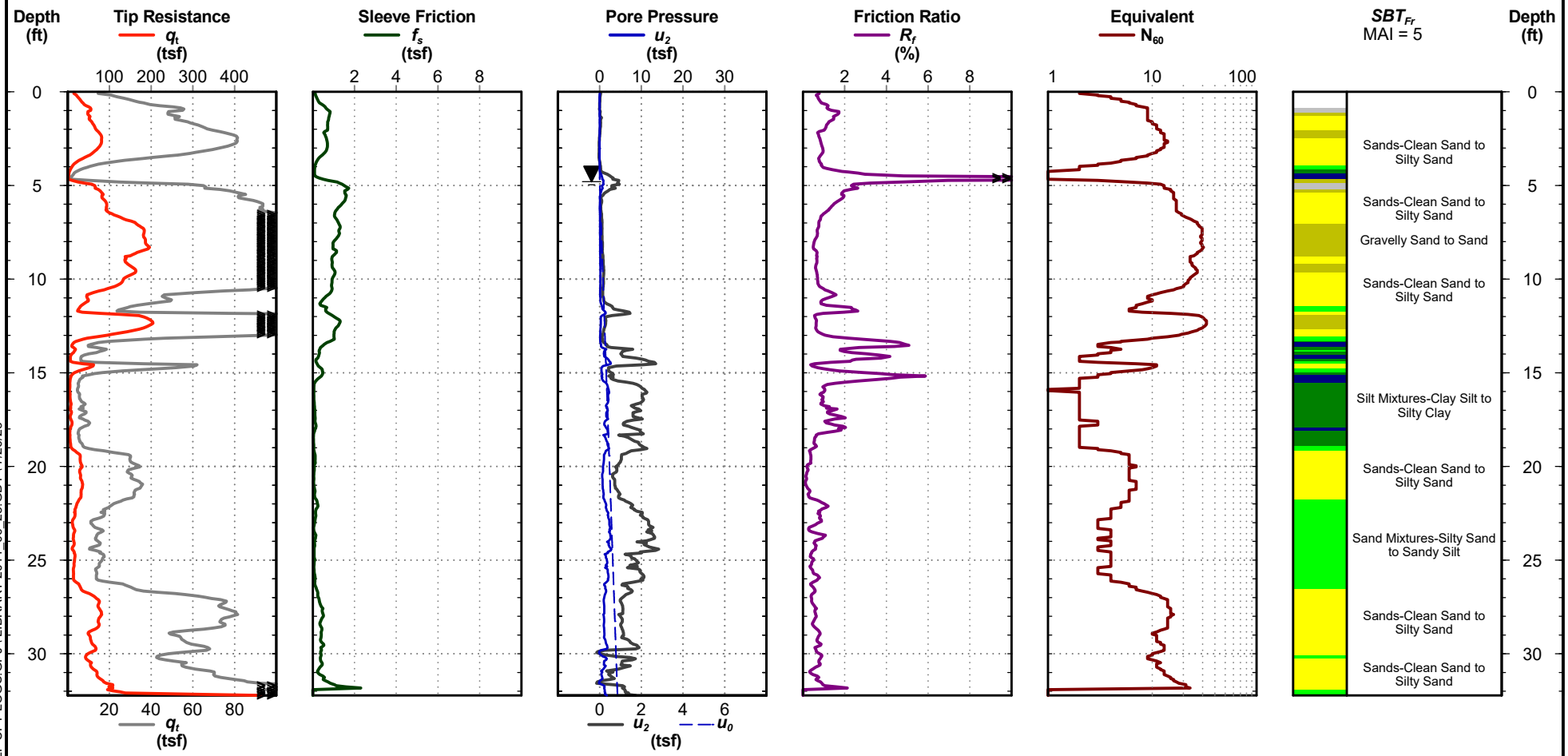
CPT REPORT - DYNAMIC \ CCU GOLF CPT LOGS.GPJ \ LIBRARY 2011_06_28.GDT \ 7/26/23

Electronic Filename: C-05.ecp

Sounding ID: C-6

CCU PGA Golf Management Program Academic Learning Lab
Conway, South Carolina
S&ME Project No: 22630133A

Date:	Jul. 24, 2023	**Total Depth:**	32.2 ft
Estimated Water Depth:	4.8 ft	**Termination Criteria:**	Maximum Reaction Force
Rig/Operator:	Marooka/D Coffee	**Cone Size:**	1.75



Cone Penetration Test

Electronic Filename: C-06.ecp

CPT REPORT - DYNAMIC \ CCU GOLF CPT LOGS.GPJ \ LIBRARY 2011_06_28.GDT \ 7/26/23

LEGEND TO SOIL CLASSIFICATION AND SYMBOLS

SOIL TYPES

(Shown in Graphic Log)


Fill


Asphalt


Concrete


Topsoil


Gravel


Sand


Silt


Clay


Organic


Silty Sand


Clayey Sand


Sandy Silt


Clayey Silt


Sandy Clay


Silty Clay


Partially Weathered Rock


Cored Rock

WATER LEVELS

(Shown in Water Level Column)

▽ = Water Level At Termination of Boring
▼ = Water Level Taken After 24 Hours
◄ = Loss of Drilling Water
HC = Hole Cave

CONSISTENCY OF COHESIVE SOILS

CONSISTENCY	STD. PENETRATION RESISTANCE BLOWS/FOOT
Very Soft	0 to 2
Soft	3 to 4
Firm	5 to 8
Stiff	9 to 15
Very Stiff	16 to 30
Hard	31 to 50
Very Hard	Over 50

RELATIVE DENSITY OF COHESIONLESS SOILS

RELATIVE DENSITY	STD. PENETRATION RESISTANCE BLOWS/FOOT
Very Loose	0 to 4
Loose	5 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	Over 50

SAMPLER TYPES

(Shown in Samples Column)

Shelby Tube


Split Spoon


Rock Core


No Recovery

TERMS

Standard Penetration Resistance - The Number of Blows of 140 lb. Hammer Falling 30 in. Required to Drive 1.4 in. I.D. Split Spoon Sampler 1 Foot. As Specified in ASTM D-1586.

REC - Total Length of Rock Recovered in the Core Barrel Divided by the Total Length of the Core Run Times 100%.

RQD - Total Length of Sound Rock Segments Recovered that are Longer Than or Equal to 4" (mechanical breaks excluded) Divided by the Total Length of the Core Run Times 100%.

PROJECT:	CCU PGA Golf Managment Academic Learning Lab Conway, South Carolina 22630133	HAND AUGER BORING LOG: C-1
DATE STARTED: 9/2/22	DATE FINISHED: 9/2/22	NOTES: Elevation Unknown.
SAMPLING METHOD: Hand Auger	PERFORMED BY: S&ME/J. Prevatte	
WATER LEVEL: 3' ATD		

Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL
		TOPSOIL - 3 inches.		
		SILTY SAND (SM) - FILL - Tan and brown, mostly fine to medium sand, some low plasticity to non-plastic fines, moist.		
1		**POORLY GRADED SAND WITH SILT (SP-SM)** - Tan and gray, mostly fine to medium sand, few low plasticity to non-plastic fines, wet.		
2				
3		Boring terminated at 3 ft due to auger refusal		▽

DCP INDEX IS THE DEPTH (IN.) OF PENETRATION PER BLOW OF A 10.1 LB HAMMER FALLING 22.6 IN., DRIVING A 0.79 IN. O.D. 60 DEGREE CONE.

PROJECT: **CCU PGA Golf Managment Academic Learning Lab**
Conway, South Carolina
22630133

HAND AUGER BORING LOG: C-2

DATE STARTED: **9/2/22** DATE FINISHED: **9/2/22**

NOTES:
Elevation Unknown.

SAMPLING METHOD: **Hand Auger** PERFORMED BY: **S&ME/J. Prevatte**

WATER LEVEL: 3' ATD

Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL
		TOPSOIL - 3 inches.		
		SILTY SAND (SM) - FILL - Tan and brown, mostly fine to medium sand, some low plasticity to non-plastic fines, some marine shell fragments, moist.		
1		**SILTY SAND (SM)** - Tan, mostly fine to medium sand, some low plasticity to non-plastic fines, moist.		
2				
		POORLY GRADED SAND WITH SILT (SP-SM) - Tan and gray, mostly fine to medium sand, few low plasticity to non-plastic fines, wet.		
3		Boring terminated at 3 ft due to auger refusal		▽

DCP INDEX IS THE DEPTH (IN.) OF PENETRATION PER BLOW OF A 10.1 LB HAMMER FALLING 22.6 IN., DRIVING A 0.79 IN. O.D. 60 DEGREE CONE.

PROJECT: **CCU PGA Golf Managment Academic Learning Lab**
Conway, South Carolina
22630133

HAND AUGER BORING LOG: C-3

DATE STARTED: **9/2/22** DATE FINISHED: **9/2/22**

NOTES:
Elevation Unknown.

SAMPLING METHOD: **Hand Auger** PERFORMED BY: **S&ME/J. Prevatte**

WATER LEVEL: 3' ATD

Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL
		TOPSOIL - 3 inches.		
1		**SILTY SAND (SM) - FILL** - Tan and brown, mostly fine to medium sand, some low plasticity to non-plastic fines, some marine shell fragments, moist.		
2		**POORLY GRADED SAND WITH SILT (SP-SM)** - Tan and gray, mostly fine to medium sand, few low plasticity to non-plastic fines, wet.		
3		Boring terminated at 3 ft due to auger refusal		▽

DCP INDEX IS THE DEPTH (IN.) OF PENETRATION PER BLOW OF A 10.1 LB HAMMER FALLING 22.6 IN., DRIVING A 0.79 IN. O.D. 60 DEGREE CONE.

PROJECT:	CCU PGA Golf Managment Academic Learning Lab Conway, South Carolina 22630133	**HAND AUGER BORING LOG: C-4**
DATE STARTED: **9/2/22**	DATE FINISHED: **9/2/22**	NOTES: Elevation Unknown.
SAMPLING METHOD: **Hand Auger**	PERFORMED BY: **S&ME/J. Prevatte**	
WATER LEVEL: **3' ATD**		

Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL
		TOPSOIL - 3 inches.		
		SILTY SAND (SM) - FILL - Tan and brown, mostly fine to medium sand, some low plasticity to non-plastic fines, some marine shell fragments, moist.		
1		**SILTY SAND (SM)** - Tan, mostly fine to medium sand, some low plasticity to non-plastic fines, moist.		
2				
		POORLY GRADED SAND WITH SILT (SP-SM) - Tan and gray, mostly fine to medium sand, few low plasticity to non-plastic fines, wet.		
3		Boring terminated at 3 ft due to auger refusal		▽

DCP INDEX IS THE DEPTH (IN.) OF PENETRATION PER BLOW OF A 10.1 LB HAMMER FALLING 22.6 IN., DRIVING A 0.79 IN. O.D. 60 DEGREE CONE.

PROJECT:	**CCU PGA Golf Managment Academic Learning Lab** **Conway, South Carolina** **22630133A**	**HAND AUGER BORING LOG: C-5**
DATE STARTED: **7/24/23**	DATE FINISHED: **7/24/23**	NOTES: Elevation Unknown.
SAMPLING METHOD: **Hand Auger**	PERFORMED BY: **J. Lighthall**	
WATER LEVEL: **Not Encountered.**		

Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL
1		**FILL - POORLY GRADED SAND WITH SILT (SP-SM)** - Mostly fine to medium sand, few non plastic fines, trace organics, dark brown, moist. - - - - Gray and yellow, large root encountered. Boring terminated at 1.1 ft due to auger refusal Auger Refusal on Large Root		–

DCP INDEX IS THE DEPTH (IN.) OF PENETRATION PER BLOW OF A 10.1 LB HAMMER FALLING 22.6 IN., DRIVING A 0.79 IN. O.D. 60 DEGREE CONE.

PROJECT:	CCU PGA Golf Managment Academic Learning Lab Conway, South Carolina 22630133A	HAND AUGER BORING LOG: C-5A
DATE STARTED: 7/24/23	DATE FINISHED: 7/24/23	NOTES: Elevation Unknown.
SAMPLING METHOD: Hand Auger	PERFORMED BY: J. Lighthall	
WATER LEVEL: 4.5' ATD.		

Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL
1		**FILL - SILTY SAND (SM)** - Mostly fine to medium sand, some non plastic fines, trace clayey inclusions, trace organics, dark brown, moist.		
		- - - - Gray and yellow.		
		- - - - Dark brown and black, Some organics from 19 inches to 29 inches.		
2		**SILTY SAND (SM)** - Mostly fine to medium sand, some non plastic to low plasticity fines, some organics, black, moist.		
		SILTY SAND (SM) - Mostly fine to medium sand, some non plastic fines, trace organics, gray, moist.		
3		**POORLY GRADED SAND WITH SILT (SP-SM)** - Mostly fine to medium sand, few non plastic fines, trace organics, gray, moist.		
4		- - - - Wet.		▽
		POORLY GRADED SAND (SP) - Mostly fine to coarse sand, trace non plastic fines, gray, wet.		
5				
6		Boring terminated at 6 ft Target Depth		

DCP INDEX IS THE DEPTH (IN.) OF PENETRATION PER BLOW OF A 10.1 LB HAMMER FALLING 22.6 IN., DRIVING A 0.79 IN. O.D. 60 DEGREE CONE.

PROJECT:	CCU PGA Golf Managment Academic Learning Lab Conway, South Carolina 22630133A	HAND AUGER BORING LOG: C-6
DATE STARTED: 7/24/23	DATE FINISHED: 7/24/23	NOTES: Elevation Unknown.
SAMPLING METHOD: Hand Auger	PERFORMED BY: J. Lighthall	
WATER LEVEL: 4.8' ATD.		

Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL
1		**FILL - SILTY SAND (SM)** - Mostly fine to medium sand, some non plastic fines, trace organics, dark brown, moist.		
2		- - - - Few organics from 19 inches to 24 inches. - - - - Trace organics.		
3		**POORLY GRADED SAND (SP)** - Mostly fine to medium sand, trace non plastic fines, brownish light gray, moist. - - - - Yellow.		
4		- - - - Gray.		
5		**POORLY GRADED SAND WITH SILT (SP-SM)** - Mostly fine to medium sand, few non plastic fines, gray, wet.		▽
6		Boring terminated at 6 ft Target Depth		

DCP INDEX IS THE DEPTH (IN.) OF PENETRATION PER BLOW OF A 10.1 LB HAMMER FALLING 22.6 IN., DRIVING A 0.79 IN. O.D. 60 DEGREE CONE.

PROJECT: **CCU PGA Golf Managment Academic Learning Lab**
Conway, South Carolina
22630133

HAND AUGER BORING LOG: HA-1

DATE STARTED: **9/2/22** DATE FINISHED: **9/2/22**

NOTES:
Elevation Unknown.

SAMPLING METHOD: **Hand Auger** PERFORMED BY: **S&ME/J. Prevatte**

WATER LEVEL: 3' ATD

Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL	DYNAMIC CONE PENETRATION RESISTANCE (blows/1.75 in.) 10 20 30 60 80	DCP VALUE
		ASPHALT - 2.5 inches.				
		POORLY GRADED SAND WITH SILT (SP-SM) - FILL - Medium dense, tan and brown, mostly fine to medium sand, few low plasticity to non-plastic fines, some marine shell fragments, moist.				20+
1		**POORLY GRADED SAND WITH SILT (SP-SM)** - Medium dense, tan and brown, mostly fine to medium sand, few low plasticity to non-plastic fines, moist.				14
2						20+
3		- - - Tan and gray, wet.		▽		12
		Boring terminated at 3.5 ft due to auger refusal				

DCP INDEX IS THE DEPTH (IN.) OF PENETRATION PER BLOW OF A 10.1 LB HAMMER FALLING 22.6 IN., DRIVING A 0.79 IN. O.D. 60 DEGREE CONE.

PROJECT: **CCU PGA Golf Managment Academic Learning Lab**
Conway, South Carolina
22630133

HAND AUGER BORING LOG: HA-2

DATE STARTED: **9/2/22** DATE FINISHED: **9/2/22**

NOTES:
Elevation Unknown.

SAMPLING METHOD: **Hand Auger** PERFORMED BY: **S&ME/J. Prevatte**

WATER LEVEL: 3' ATD

Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL	DYNAMIC CONE PENETRATION RESISTANCE (blows/1.75 in.) 10 20 30 60 80	DCP VALUE
		ASPHALT - 1.5 inches.				
		POORLY GRADED SAND (SP) - FILL - Medium dense to loose, tan and brown, mostly fine to medium sand, trace fines, some marine shell fragments, moist.				20+
1		**POORLY GRADED SAND WITH SILT (SP-SM)** - Loose, tan and brown, mostly fine to medium sand, few low plasticity to non-plastic fines, moist.				8
2		- - - Medium dense.				15
		- - - Loose, tan and gray, wet.				
3		Boring terminated at 3 ft due to auger refusal				7

DCP INDEX IS THE DEPTH (IN.) OF PENETRATION PER BLOW OF A 10.1 LB HAMMER FALLING 22.6 IN., DRIVING A 0.79 IN. O.D. 60 DEGREE CONE.

PROJECT: **CCU PGA Golf Managment Academic Learning Lab**
Conway, South Carolina
22630133

HAND AUGER BORING LOG: HA-3

DATE STARTED: **9/2/22** DATE FINISHED: **9/2/22**

NOTES:
Elevation Unknown.

SAMPLING METHOD: **Hand Auger** PERFORMED BY: **S&ME/J. Prevatte**

WATER LEVEL: 3' ATD

Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL	DYNAMIC CONE PENETRATION RESISTANCE (blows/1.75 in.) 10 20 30 60 80	DCP VALUE
		ASPHALT - 2 inches.				
		POORLY GRADED SAND WITH SILT (SP-SM) - FILL - Medium dense, tan and brown, mostly fine to medium sand, few low plasticity to non-plastic fines, some marine shell fragments, moist.				20+
1		**SILTY SAND (SM)** - Medium dense, tan and brown, mostly fine to medium sand, some low plasticity to non-plastic fines, moist.				20+
2		**CLAYEY SAND (SC)** - Loose, dark brown, mostly fine to medium sand, some low to medium plasticity fines, trace organics, wet.				8
3		**POORLY GRADED SAND WITH SILT (SP-SM)** - Very loose, tan and gray, mostly fine to medium sand, few low plasticity to non-plastic fines, wet.		▽		3
4		Boring terminated at 4 ft Target Depth				1

DCP INDEX IS THE DEPTH (IN.) OF PENETRATION PER BLOW OF A 10.1 LB HAMMER FALLING 22.6 IN., DRIVING A 0.79 IN. O.D. 60 DEGREE CONE.

PROJECT: **CCU PGA Golf Managment Academic Learning Lab**
Conway, South Carolina
22630133

HAND AUGER BORING LOG: HA-4

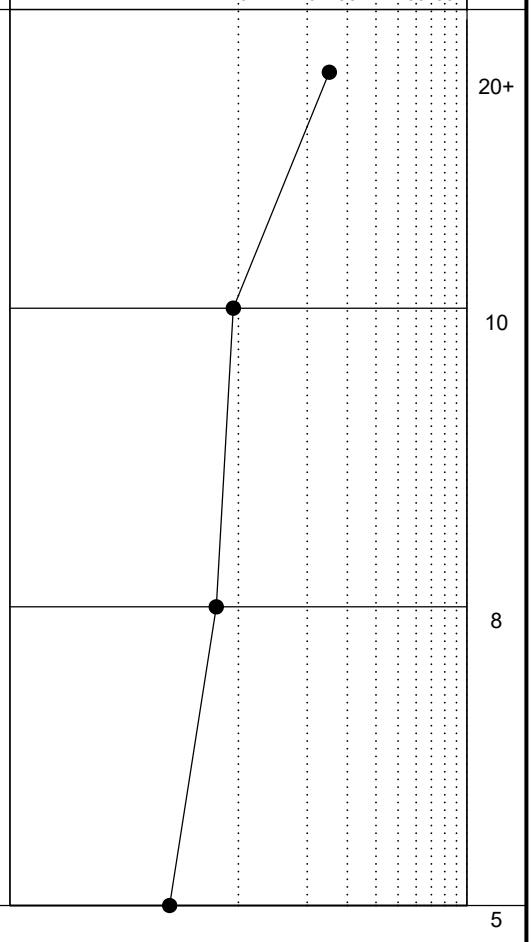
DATE STARTED: **9/2/22** DATE FINISHED: **9/2/22**

NOTES:
Elevation Unknown.

SAMPLING METHOD: **Hand Auger** PERFORMED BY: **S&ME/J. Prevatte**

WATER LEVEL: 3' ATD

Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL
		ASPHALT - 2.5 inches.		
		POORLY GRADED SAND WITH SILT (SP-SM) - FILL - Medium dense, tan and brown, mostly fine to medium sand, few low plasticity to non-plastic fines, some marine shell fragments, moist.		
1		**POORLY GRADED SAND WITH SILT (SP-SM)** - Loose, tan and brown, mostly fine to medium sand, few low plasticity to non-plastic fines, moist.		
2		- - - Tan and gray, wet.		
3		Boring terminated at 3 ft due to auger refusal		



DCP INDEX IS THE DEPTH (IN.) OF PENETRATION PER BLOW OF A 10.1 LB HAMMER FALLING 22.6 IN., DRIVING A 0.79 IN. O.D. 60 DEGREE CONE.

PROJECT: **CCU PGA Golf Managment Academic Learning Lab**
Conway, South Carolina
22630133

HAND AUGER BORING LOG: HA-5

DATE STARTED: **9/2/22** DATE FINISHED: **9/2/22**

NOTES:
Elevation Unknown.

SAMPLING METHOD: **Hand Auger** PERFORMED BY: **S&ME/J. Prevatte**

WATER LEVEL: 3' ATD

Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL	DYNAMIC CONE PENETRATION RESISTANCE (blows/1.75 in.) 10 20 30 60 80	DCP VALUE
		ASPHALT - 2 inches.				
		POORLY GRADED SAND WITH SILT (SP-SM) - FILL - Medium dense, tan and brown, mostly fine to medium sand, few low plasticity to non-plastic fines, some marine shell fragments, moist.				20+
1		**POORLY GRADED SAND WITH SILT (SP-SM)** - Medium dense, tan and brown, mostly fine to medium sand, few low plasticity to non-plastic fines, moist.				6
2						10
3		Boring terminated at 3 ft due to auger refusal		▽		7

DCP INDEX IS THE DEPTH (IN.) OF PENETRATION PER BLOW OF A 10.1 LB HAMMER FALLING 22.6 IN., DRIVING A 0.79 IN. O.D. 60 DEGREE CONE.

Appendix III – Laboratory Procedures and Data

♦ Summary of Laboratory Test Procedures

Moisture Content Testing of Soil Samples by Oven Drying

Moisture content was determined in general conformance with the methods outlined in ASTM D 2216, "*Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil or Rock by Mass*." This method is limited in scope to Group B, C, or D samples of earth materials which do not contain appreciable amounts of organic material, soluble solids such as salt or reactive solids such as cement. This method is also limited to samples which do not contain contamination.

A representative portion of the soil was divided from the sample using one of the methods described in Section 9 of ASTM D 2216. The split portion was then placed in a drying oven and heated to approximately 110 degrees C overnight or until a constant mass was achieved after repetitive weighing. The moisture content of the soil was then computed as the mass of water removed from the sample by drying, divided by the mass of the sample dry, times 100 percent. No attempt was made to exclude any particular particle size from the portion split from the sample.

Wash No. 200 Sieve

The distribution of particle sizes greater than 75 mm was determined in general accordance with the procedures described by ASTM D 421, "*Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants*".

A selected specimen of soils was washed over a No. 200 sieve after being thoroughly mixed and dried. This test was conducted in general accordance with ASTM D 1140, "*Standard Test Method for Amount of Material Finer Than the No. 200 Sieve*." Method B, using a hexametaphosphate solution to pre-soak the specimen for at least 2 hours, was used to prepare the sample. The sample is then washed through the No. 200 sieve the percentage by weight of material washed through the sieve was deemed the "percent fines" or percent clay and silt fraction.

Percent Organics (Organic Loss on Ignition)

The content of relatively undecayed or undecomposed vegetative matter in the soils is determined for representative samples of topsoil or stained subsoils using the procedures described by AASHTO T-267, "*Determination of Organic Content in Soils by Loss on Ignition.*" Representative samples of the minus No. 10 sieve size are first dried at a constant temperature of 105 C, then heated in a muffle furnace at 455 C for six hours. The resulting dry weight of the sample after ignition is then compared to the pre-ignition dry weight to estimate the organic content.

Summary of Laboratory Test Procedures - Continued

Compaction Tests of Soils Using Modified Effort

Soil placed as engineering fill is compacted to a dense state to obtain satisfactory engineering properties. Laboratory compaction tests provide the basis for determining the percent compaction and water content needed to achieve the required engineering properties, and for controlling construction to assure the required compaction and water contents are achieved. Test procedures generally followed those described by ASTM D 1557, "Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 lbf/ft3)." The relationship between water content and the dry unit weight is determined for soils compacted in a 4 inch diameter molds with a 10 lb rammer dropped from a height of 18 inches, producing a compactive effort of 56,000 lbf/ft3.

Soil was compacted in the mold in five layers of approximately equal thickness, each compacted with 25 blows of the rammer. After compaction of the sample in the mold, the resulting dry density and moisture content was determined and the procedure repeated. Separate soils were used for each sample point, adjusting the moisture content of the soil as described in Section 10.2 (Moist Preparation Method). The procedure was repeated for a sufficient number of water content values to allow the dry density vs. water content values to be plotted and the maximum dry density and optimum moisture content to be determined from the resulting curvilinear relationship.

Laboratory California Bearing Ratio (CBR) Tests of Compacted Samples

This method is used to evaluate the potential strength of subgrade, subbase, and base course material, including recycled materials, for use in road and airfield pavements. Laboratory CBR tests were performed in general accordance with the procedures described in ASTM D 1883, "*Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils*." Specimens were prepared in standard molds to a target level of compactive effort within plus or minus 0.5 percent of the optimum moisture content value. While embedded in the compaction mold, each sample was inundated for a minimum period of 96 hours to achieve saturation. During inundation the specimen was surcharged by a weight approximating the anticipated weight of the pavement and base course layers; see the report form for the surcharge weight selected for each sample. After removing the sample from the soaking bath, the soil was then sheared by jacking a piston having a cross sectional area of 3 square inches into the end surface of the specimen. The piston was jacked 0.5 inches into the specimen at a constant rate of 0.05 inches per minute.

The CBR is defined as the load required to penetrate a material to a predetermined depth, compared to the load required to penetrate a standard sample of crushed stone to the same depth. The CBR value is usually based on the load ratio for a penetration of 0.10 inches, after correcting the load-deflection curves for surface irregularities or upward concavity. However, where the calculated (corrected) CBR for a penetration of 0.20 inches is greater than the result obtained for a penetration of 0.10 inches, the test is repeated by reversing the specimen and shearing the opposite end surface. Where the second ("flip") test indicates a greater CBR value at 0.20 inches of penetration, the CBR for 0.20 inches penetration is used for design.

Form No: TR-D2216-T265-1
Revision No. 1
Revision Date: 08/16/17

LABORATORY DETERMINATION OF WATER CONTENT

ASTM D 2216 ☑ *AASHTO T 265* ☐

S&ME, Inc. - Myrtle Beach: 1330 Highway 501 Business, Conway, SC 29526

Project #:	22630133	Report Date:	9/16/2022
Project Name:	CCU PGA Golf Mgmt Learning Lab	Test Date(s):	9/12/2022
Client Name:	Coastal Carolina University		
Client Address:	PO Box 261954; Conway, SC 29526		
Sample by:	J. Prevatte	Sample Date(s):	9/2/2022

Method: **A (1%)** ☐ **B (0.1%)** ☑ Balance ID. 19608 Calibration Date: 2/25/22 Oven ID. 17745 Calibration Date: 4/5/22

Boring No.	Sample No.	Sample Depth	Tare #	Tare Weight	Tare Wt.+ Wet Wt	Tare Wt. + Dry Wt	Water Weight	Percent Moisture	Note
		ft. or m.		grams	grams	grams	grams	%	
HA-1 to HA-4	Bulk	1'-3'	DDD	82.4	289.6	262.4	27.20	**15.1%**	
HA-2	S-1	0.2'-0.5'	N	80.5	308.5	271.0	37.50	**19.7%**	
C-3	S-3	2'-3'	Black	83.5	300.6	281.9	18.70	**9.4%**	

Notes / Deviations / References

ASTM D 2216: Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

Ron Forest, P.E.	*Ron Forest*	Principal Engineer	9/16/2022
Technical Responsibility	*Signature*	*Position*	*Date*

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Form No: TR-D2216-T265-1
Revision No. 1
Revision Date: 08/16/17

LABORATORY DETERMINATION OF WATER CONTENT

ASTM D 2216 ☑ *AASHTO T 265* ☐

S&ME, Inc. - Myrtle Beach: 1330 Highway 501 Business, Conway, SC 29526

Project #:	22630133A	Report Date:	7/31/2023
Project Name:	CCU PGA Golf Management Program Academic Learning Lab	Test Date(s):	7/26/2023
Client Name:	Coastal Carolina University		
Client Address:	PO Box 261954, Conway, South Carolina		
Sample by:	J. Lighthall	Sample Date(s):	7/24/2023

Method: **A (1%)** ☐ **B (0.1%)** ☑ Balance ID. 33444 Calibration Date: 7/10/2024 Oven ID. 17745 Calibration Date: 9/27/2022

Boring No.	Sample No.	Sample Depth	Tare #	Tare Weight	Tare Wt.+ Wet Wt	Tare Wt. + Dry Wt	Water Weight	Percent Moisture	Note
		ft. or m.		grams	grams	grams	grams	%	
C-6	S-1	0-6"	VWX	82.7	362.4	335.6	26.80	10.6%	
C-5A	S-4	29"-34"	Helen	72.7	324.1	291.2	32.90	15.1%	

Notes / Deviations / References

ASTM D 2216: Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

Jason S. McGough	*Jason S. Mcgough*	Lab Supervisor	7/31/2023
Technician	*Signature*	*Position*	*Date*
Ron Forest, P.E.	*RPF*	Principal Engineer	7/31/2023
Technical Responsibility	*Signature*	*Position*	*Date*

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Form No: TR-D1140-1
Revision No. 1
Revision Date: 8/2/17

MATERIAL FINER THAN THE #200 SIEVE

ASTM D1140

S&ME, Inc. - Myrtle Beach: 1330 Highway 501 Business, Conway, SC 29526

Project #:	22630133	Report Date:	9/16/2022
Project Name:	CCU PGA Golf Mgmt Learning Lab	Test Date(s):	9/12/2022
Client Name:	Coastal Carolina University		
Client Address:	PO Box 261954; Conway, SC 29526		
Sample by:	J. Prevatte	**LAB#**	660
		Sample Dates:	9/2/2022

Method; A ☐ **B** ☑ Soaked ☑ Soak Time 2 Hrs

Boring #	Sample #	Sample Depth	Tare #	Tare Weight	Tare Wt.+ Wet Wt	Tare Wt. + Dry Wt	Tare Wt. + Dry Wt. after Wash	% Passing #200
		ft. or m.		grams	grams	grams	grams	%
HA-1 to HA-4	Bulk	1'-3'	DDD	82.4	289.6	262.4	251.7	**5.9%**
HA-2	S-1	0.2-0.5'	N	80.5	308.5	271.0	262.0	**4.7%**
C-3	S-3	2'-3'	Black	83.5	300.6	281.9	266.9	**7.6%**

Balance ID. *19608* *Calibration Date:* *2/25/22* *#200 Sieve* *18775* *Calibration Date:* *2/25/22*

Notes / Deviations / References: ASTM D1140: Amount of Material in Soil Finer Than the No. 200 (75-um)) Sieve

Ron Forest, P.E.	Ron Forest	Principal Engineer	9/16/2022
Technical Responsibility	*Signature*	*Position*	*Date*

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Form No: TR-D1140-1
Revision No. 1
Revision Date: 8/2/17

MATERIAL FINER THAN THE #200 SIEVE

ASTM D1140

S&ME, Inc. - Myrtle Beach: 1330 Highway 501 Business, Conway, SC 29526

Project #:	22630133A	Report Date:	7/31/2023
Project Name:	CCU PGA Golf Management Program Academic Learning Lab	Test Date(s):	7/26/2023
Client Name:	Coastal Carolina University		
Client Address:	PO Box 261954, Conway, South Carolina		
Sample by:	J. Lighthall	**LAB#**	801
		Sample Dates:	7/24/2023

Method; A ☐ **B** ☑ Soaked ☑ Soak Time 2 Hrs

Boring #	Sample #	Sample Depth	Tare #	Tare Weight	Tare Wt.+ Wet Wt	Tare Wt. + Dry Wt	Tare Wt. + Dry Wt. after Wash	% Passing #200
		ft. or m.		grams	grams	grams	grams	%
C-6	S-1	0-6"	VWX	82.7	362.4	335.6	299.5	**14.3%**
C-5A	S-4	29"-34"	Helen	72.7	324.1	291.2	262.4	**13.2%**

Balance ID. *33444* *Calibration Date:* *7/10/24* *#200 Sieve* *18775* *Calibration Date:* *4/5/2023*

Notes / Deviations / References: ASTM D1140: Amount of Material in Soil Finer Than the No. 200 (75-um)) Sieve

Jason S. McGough	*Jason S. MCGough*	Lab Supervisor	7/31/2023
Techinician	*Signature*	*Position*	*Date*
Ron Forest, P.E.	*RPF*	Principal Engineer	7/31/2023
Technical Responsibility	*Signature*	*Position*	*Date*

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Form No: TR-D2974-1
Revision No. 1
Revision Date: 08/26/17

MOISTURE, ASH, AND ORGANIC MATTER

ASTM D-2974

S&ME, Inc. - Myrtle Beach: 1330 Highway 501 Business, Conway, SC 29526

Project #:	22630133	Report Date:	9/16/2022
Project Name:	CCU PGA Golf Mgmt Learning Lab	Test Date(s):	9/15/2022
Client Name:	Coastal Carolina University		
Client Address:	PO Box 261954; Conway, SC 29526		

Boring #:	HA-3	Sample #:	S-1	Sample Date:	9/2/2022
Location:	Pavement Footprint	Lab #:	660	Depth:	2'-3'

Sample Description: Dark Brown Clayey Sand (SC)

Equipment: *Balance: 0.01 g.Readability, 500g. Minimum Capaccity*

Balance: *S&ME ID #:* *00401* *Cal. Date:* *2/25/22* *Due:* *2/25/23*

Method A: Moisture Content Determination *Required Oven Temperature: 105 ± 5 °C*

	Oven Temperature: 105 °C	*Tare #*	AS
t	Tare Weight *(Dish plus Aluminum Foil Cover)*	*grams*	421.90
a	Mass of *As-Received* Specimen + Tare Wt.	*grams*	994.20
b	Mass of Oven Dry Specimen + Tare Wt.	*grams*	886.20
w	Water Weight	*(a-b)*	108.00
A	Mass of As-Received Specimen	*(a-t)*	572.30
B	Mass of Oven Dry Specimen	*(b-t)*	464.30
	% Moisture Content as a % of As Received or Total Mass	*(w/A)*100*	**18.9%**
	% Moisture Content as a % of Oven-dried Mass	*(w/B)*100*	**23.3%**

Oven *S&ME ID #:* *17745* *Cal. Date:* *4/15/21* *Due:* *4/15/22*

Method C (440 °C) or D (750 °C): Ash Content and Organic Matter Determination

	Muffle Furnace: 440 °C	*Tare #*	1
t	Tare Weight *(Dish plus Aluminum Foil Cover)*	*grams*	30.36
b	Mass of Oven Dry Specimen + Tare Wt.	*grams*	94.20
c	Ash Weight + Tare Wt.	*grams*	92.33
C	Ash Weight	*c-t*	61.97
B	Mass of Oven Dry Specimen	*(b-t)*	63.84
D	***% Ash Content***	*(C/B)*100*	**97.1%**
	% Organic Matter	*100-D*	**2.9%**

Muffle Furnace: *S&ME ID #:* *N/A* *Cal. Date:* *N/A* *Due:* *N/A*

Notes / Deviations / References: ASTM D2974: Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

Ron Forest, P.E.	Ron Forest	Principal Engineer	9/16/2022
Technical Responsibility	*Signature*	*Position*	*Date*

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Form No: TR-D2974-1
Revision No. 1
Revision Date: 08/26/17

MOISTURE, ASH, AND ORGANIC MATTER

ASTM D-2974

S&ME, Inc. - Myrtle Beach: 1330 Highway 501 Business, Conway, SC 29526

Project #:	22630133A	Report Date:	7/31/2023
Project Name:	CCU PGA Golf Management Program Academic Learning Lab	Test Date(s):	7/25/2023
Client Name:	Coastal Carolina University		
Client Address:	PO Box 261954, Conway, South Carolina		
Boring #:	C-5A	Sample #: S-3	Sample Date: 7/24/2023
Location:	Hand Auger Borings	Lab #: 801	Depth: 19"-22"
Sample Description:	Dark Brown and Black Silty Sand (SM)		

Equipment: *Balance: 0.01 g.Readability, 500g. Minimum Capaccity*

Balance: *S&ME ID #:* *36158* *Cal. Date:* *10/7/2022* *Due:* *10/7/2023*

Method A: Moisture Content Determination *Required Oven Temperature: 105 ± 5 °C*

Oven Temperature: 105 °C		*Tare #*	AAA
t	Tare Weight *(Dish plus Aluminum Foil Cover)*	*grams*	77.00
a	Mass of *As-Received* Specimen + Tare Wt.	*grams*	346.00
b	Mass of Oven Dry Specimen + Tare Wt.	*grams*	294.20
w	Water Weight	*(a-b)*	51.80
A	Mass of As-Received Specimen	*(a-t)*	269.00
B	Mass of Oven Dry Specimen	*(b-t)*	217.20
	% Moisture Content as a % of As Received or Total Mass	*(w/A)*100*	**19.3%**
	% Moisture Content as a % of Oven-dried Mass	*(w/B)*100*	**23.8%**

Oven *S&ME ID #:* *17745* *Cal. Date:* *9/27/2022* *Due:* *9/27/2023*

Method C (440 °C) or D (750 °C): Ash Content and Organic Matter Determination

Muffle Furnace: 440 °C		*Tare #*	3
t	Tare Weight *(Dish plus Aluminum Foil Cover)*	*grams*	37.07
b	Mass of Oven Dry Specimen + Tare Wt.	*grams*	78.30
c	Ash Weight + Tare Wt.	*grams*	75.41
C	Ash Weight	*c-t*	38.34
B	Mass of Oven Dry Specimen	*(b-t)*	41.23
D	***% Ash Content***	*(C/B)*100*	**93.0%**
	% Organic Matter	*100-D*	**7.0%**

Muffle Furnace: *S&ME ID #:* *N/A* *Cal. Date:* *N/A* *Due:* *N/A*

Notes / Deviations / References: ASTM D2974: Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

Jason s. McGough	*Jason S. McGough*	Lab Supervisor	7/31/2023
Technician	*Signature*	*Position*	*Date*
Ron Forest, P.E.	*RPF*	Principal Enigneer	7/31/2023
Technical Responsibility	*Signature*	*Position*	*Date*

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Form No: TR-D2974-1
Revision No. 1
Revision Date: 08/26/17

MOISTURE, ASH, AND ORGANIC MATTER

ASTM D-2974

S&ME, Inc. - Myrtle Beach: 1330 Highway 501 Business, Conway, SC 29526

Project #:	22630133A	Report Date:	7/31/2023
Project Name:	CCU PGA Golf Management Program Academic Learning Lab	Test Date(s):	7/25/2023
Client Name:	Coastal Carolina University		
Client Address:	PO Box 261954, Conway, South Carolina		

Boring #:	C-6	Sample #:	S-2	Sample Date:	7/24/2023
Location:	Hand Auger Borings	Lab #:	801	Depth:	19"-24"

Sample Description: Dark Brown Silty Sand (SM)

Equipment: *Balance: 0.01 g.Readability, 500g. Minimum Capaccity*

Balance: *S&ME ID #:* *36158* *Cal. Date:* *10/7/2022* *Due:* *10/7/2023*

Method A: Moisture Content Determination *Required Oven Temperature: 105 ± 5 °C*

Oven Temperature: 105 °C		*Tare #*	M
t	Tare Weight *(Dish plus Aluminum Foil Cover)*	*grams*	76.50
a	Mass of *As-Received* Specimen + Tare Wt.	*grams*	430.20
b	Mass of Oven Dry Specimen + Tare Wt.	*grams*	372.70
w	Water Weight	*(a-b)*	57.50
A	Mass of As-Received Specimen	*(a-t)*	353.70
B	Mass of Oven Dry Specimen	*(b-t)*	296.20
	% Moisture Content as a % of As Received or Total Mass	*(w/A)*100*	**16.3%**
	% Moisture Content as a % of Oven-dried Mass	*(w/B)*100*	**19.4%**

Oven *S&ME ID #:* *17745* *Cal. Date:* *9/27/2022* *Due:* *9/27/2023*

Method C (440 °C) or D (750 °C): Ash Content and Organic Matter Determination

Muffle Furnace: 440 °C		*Tare #*	7
t	Tare Weight *(Dish plus Aluminum Foil Cover)*	*grams*	38.42
b	Mass of Oven Dry Specimen + Tare Wt.	*grams*	84.73
c	Ash Weight + Tare Wt.	*grams*	82.81
C	Ash Weight	*c-t*	44.39
B	Mass of Oven Dry Specimen	*(b-t)*	46.31
D	***% Ash Content***	*(C/B)*100*	**95.9%**
	% Organic Matter	*100-D*	**4.1%**

Muffle Furnace: *S&ME ID #:* *N/A* *Cal. Date:* *N/A* *Due:* *N/A*

Notes / Deviations / References: ASTM D2974: Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

Jason s. McGough	*Jason S. McGough*	Lab Supervisor	7/31/2023
Technician	*Signature*	*Position*	*Date*
Ron Forest, P.E.	*RPF*	Principal Enigneer	7/31/2023
Technical Responsibility	*Signature*	*Position*	*Date*

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Form No. TR-D698-2
Revision No. : 1
Revision Date: 07/25/17

MOISTURE - DENSITY REPORT

Quality Assurance

S&ME, Inc. - Myrtle Beach: 1330 Highway 501 Business, Conway, SC 29526

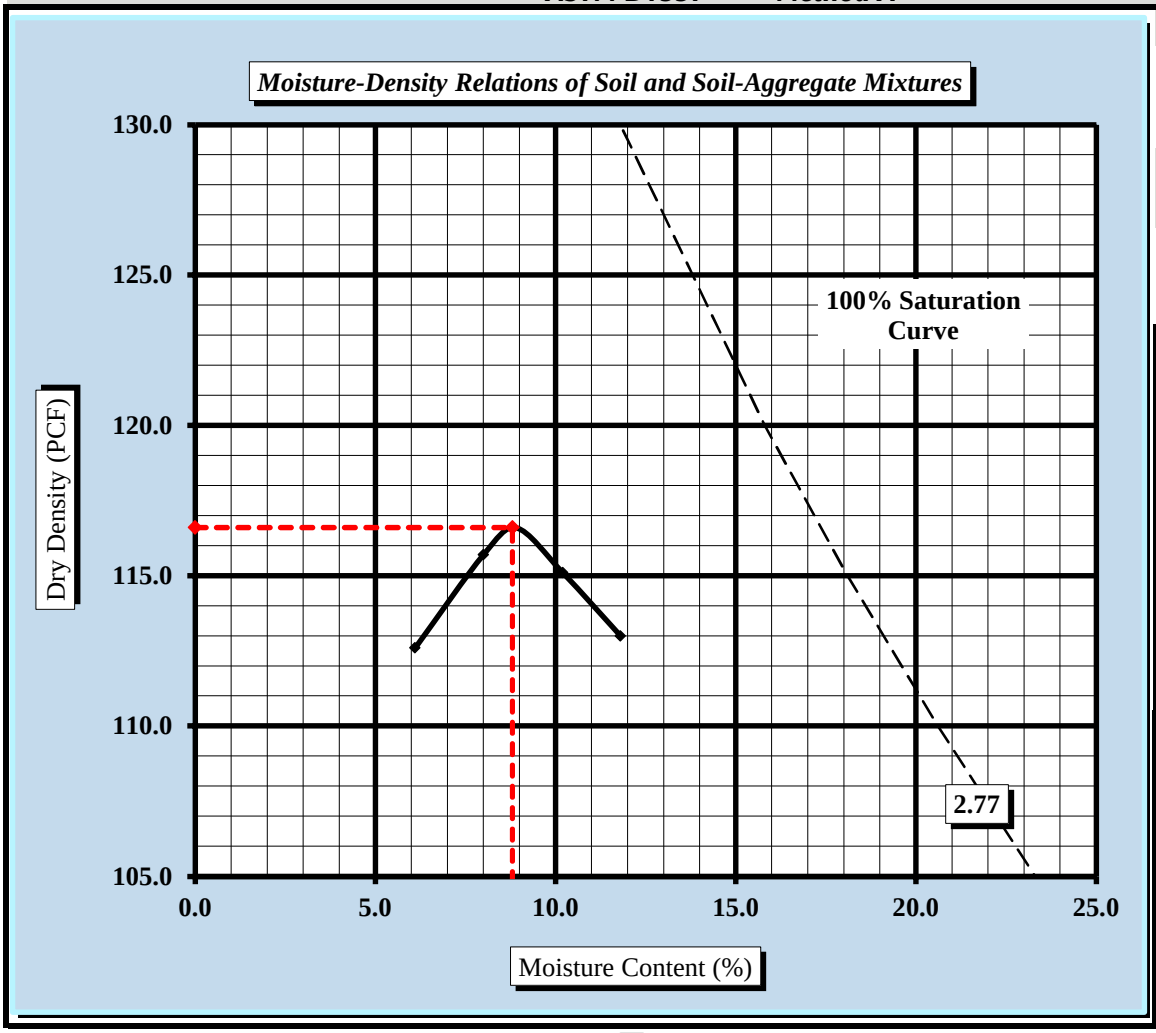
S&ME Project #:	22630133	Report Date:	9/16/2022
Project Name:	CCU PGA Golf Mgmt Learning Lab	Test Date(s):	9/9/2022
Client Name:	Coastal Carolina University		
Client Address:	PO Box 261954; Conway, SC 29526		

Boring #:	HA-1 to HA-4	Sample #:	Bulk	Sample Date:	9/2/2022
Location:	Pavement Footprint	Lab #:	660	Depth:	1'-3'

Sample Description: Brown and Tan Poorly Graded Sand with Silt (SP-SM)

Maximum Dry Density **116.6** **PCF.** **Optimum Moisture Content** **8.8%**

ASTM D1557 - - Method A



Soil Properties	
Natural Moisture Content	15.1%
Specific Gravity of Soil	--
Liquid Limit	--
Plastic Limit	--
Plastic Index	--
% Passing	
3/4"	--
3/8"	--
#4	--
#10	--
#40	--
#60	--
#200	5.9%
Oversize Fraction	
Bulk Gravity	--
% Moisture	--
% Oversize	--
MDD	--
Opt. MC	--

Moisture-Density Curve Displayed: Fine Fraction ☒ Corrected for Oversize Fraction (ASTM D 4718) ☐

Sieve Size used to separate the Oversize Fraction: #4 Sieve ☒ 3/8 inch Sieve ☐ 3/4 inch Sieve ☐

Mechanical Rammer ☒ Manual Rammer ☐ Moist Preparation ☐ Dry Preparation ☒

References / Comments / Deviations:

ASTM D 2216: Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

ASTM D 1557: Laboratory Compaction Characteristics of Soil Using Modified Effort

Ron Forest, P.E.	Ron Forest	Principal Engineer	9/16/2022
Technical Responsibility	*Signature*	*Position*	*Date*

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Form No. TR-D1883-T193-3
Revision No. 2
Revision Date: 08/11/17

CBR (CALIFORNIA BEARING RATIO) OF LABORATORY COMPACTED SOIL

ASTM D 1883

S&ME, Inc. - Myrtle Beach: 1330 Highway 501 Business, Conway, SC 29526

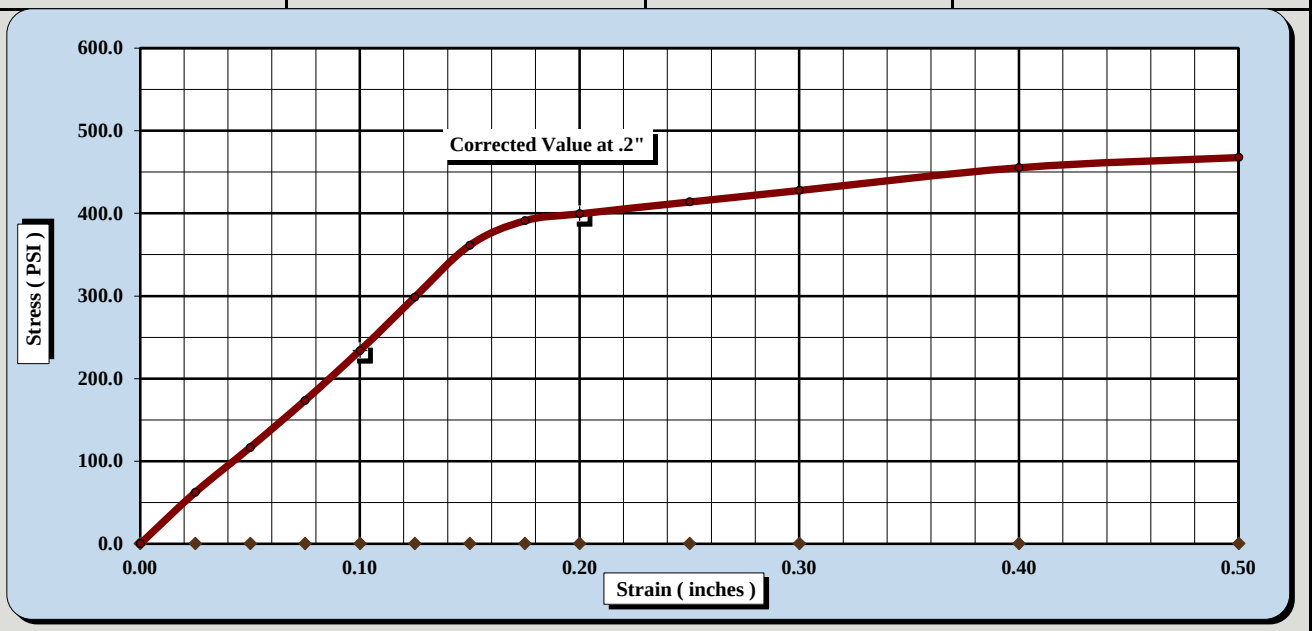
Project #:	22630133	Report Date:	9/16/2022
Project Name:	CCU PGA Golf Mgmt Learning Lab	Test Date(s)	9/12/2022
Client Name:	Coastal Carolina University		
Client Address:	PO Box 261954; Conway, SC 29526		
Boring #:	HA-1 to HA-4	Sample #: Bulk	Sample Date: 9/2/2022
Location:	Pavement Footprint	LAB #: 660	Depth: 1'-3'

Sample Description: Brown and Tan Poorly Graded Sand with Silt (SP-SM)

ASTM D1557 *Method A* Maximum Dry Density: 116.6 PCF Optimum Moisture Content: 8.8%

Compaction Test performed on grading complying with CBR spec. % Retained on the 3/4" sieve: 1.0%

Uncorrected CBR Values		Corrected CBR Values	
CBR at 0.1 in. 23.4	CBR at 0.2 in. 26.6	CBR at 0.1 in. 23.4	CBR at 0.2 in. 26.6



CBR Sample Preparation:

The entire gradation was used and compacted in a 6" CBR mold in accordance with ASTM D1883, Section 6.1.1

Before Soaking		*After Soaking*	
Compactive Effort (Blows per Layer)	25		
Initial Dry Density (PCF)	111.4	Final Dry Density (PCF)	111.4
Moisture Content of the Compacted Specimen	8.9%	Moisture Content (top 1" after soaking)	16.0%
Percent Compaction	95.5%	Percent Swell	0.0%

Soak Time: 96 hrs. Surcharge Weight 20.0 Surcharge Wt. per sq. Ft. 102.0

Liquid Limit -- Plastic Index -- Apparent Relative Density --

Notes/Deviations/References: Liquid Limit: ASTM D 4318, Specific Gravity: ASTM D 854, Classification: ASTM D 2487

Ron Forest, P.E.	Ron Forest	Principal Engineer	9/16/2022
Technical Responsibility	*Signature*	*Position*	*Date*

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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work performed by Owner.
5. Work under Owner's separate contracts.
6. Future work not part of this Project.
7. Owner-furnished/Contractor-installed (OFCI) products.
8. Contractor's use of site and premises.
9. Coordination with occupants.
10. Work restrictions.
11. Specification and Drawing conventions.
12. Existing Conditions
13. Quality of Work
14. Contractor Supervision
15. Job Sign
16. Inspections, Testing and Special Inspections
17. Permits & Licenses
18. Tree Care and Maintenance Plan

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
2. Section 017300 "Execution" for coordination of Owner-installed products.

1.3 PROJECT INFORMATION

A. Project Identification: CCU PGA Golf Facility

1. Project Location: (Hackler Golf Course) 107 Citadel Drive, Conway SC 29526

B. Owner: Coastal Carolina University

1. Owner's Representative: Mr. Shawn Godwin, Project Manager, Facilities Planning and Construction, Coastal Carolina University, 843-349-2672 (phone).

C. Architect: Quackenbush Architects + Planners.

1. Architect's Representative: Barbara Haller.

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

1. Civil Engineers: Development Resource Group (DRG)

2. Landscape Architect: TrueDesign Studio

3. Food Service Consultant: National Restaurant Design.

4. Structural Engineer: Weatherly Structural Engineers

5. Mechanical, Electrical, and Plumbing Engineers: RMF Engineering has prepared the following portions of the Contract Documents:

a. Mechanical Engineer: Zachary Lander
b. Plumbing Engineer: Zachary Lander
c. Fire Protection Engineer: Zachary Lander
d. Electrical Engineer: Beth Crutchfield

6. Commissioning: Whole Building Systems

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

1. See Section 013100 "Project Management and Coordination." for requirements for using web-based Project software.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:

1. Approximately 16,000 square foot two story building including classrooms, pro-shop, dining area and kitchen. Work includes but is not limited to sitework, landscape, masonry, structural steel, storefront, interior finishes, food service equipment, elevator, electrial, mechanical, plumbing and fire protection and other Work indicated in the Contract Documents. Demolition and abatement of the existing clubhouse is included in the scope as an alternate. The project is expected to achieve Two Green Globes.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.5 PHASED CONSTRUCTION

A. Construct the Work in phases, with each phase substantially complete as indicated on Drawings and below.

1. Phase 1: Construction of the new PGA facility.

a. Commencement of Construction:

1) Notice to Proceed: Work of this phase shall commence within 14 after the Notice to Proceed.

2. Phase 2: Perform the remaining Work. The remaining Work shall be substantially complete at time of Substantial Completion of the Work. Coordination with asbestos abatement by Owner will be required before demolition of the existing facility may commence. Allow 3 weeks after Certificate of Occupancy of PGA Facility for Owner to move out of the existing building and to remove asbestos from the existing building. The remaining Work includes the demolition of the existing facility and the sitework in that area of the site.

B. Before commencing Work of each phase, submit an updated copy of Contractor's construction schedule, showing the sequence, commencement and completion dates, and move-out and -in dates of Owner's personnel for all phases of the Work.

1.6 WORK UNDER OWNER'S SEPARATE CONTRACTS

A. Work with Separate Contractors: Cooperate fully with Owner's separate contractors, so work on those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under Owner's separate contracts.

B. Concurrent Work: Owner will award separate contract(s) for the following construction operations at Project site. Those operations will be conducted simultaneously with Work under this Contract.

1. Demolition and Asbestos Abatement (unless alternate is accepted)

2. Upfit of pro-shop.

3. Upfit of Simulation lab.

1.7 OWNER-FURNISHED/CONTRACTOR-INSTALLED (OFCI) PRODUCTS

A. Owner's Responsibilities: Owner will furnish products indicated and perform the following, as applicable:

1. Provide to Contractor Owner-reviewed Product Data, Shop Drawings, and Samples.
2. Provide for delivery of Owner-furnished products to Project site.

3. Upon delivery, inspect, with Contractor present, delivered items.

    a. If Owner-furnished products are damaged, defective, or missing, arrange for replacement.

4. Obtain manufacturer's inspections, service, and warranties.
5. Inform Contractor of earliest available delivery date for Owner-furnished products.

B. Contractor's Responsibilities: The Work includes the following, as applicable:

1. Designate delivery dates of Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available delivery dates.
2. Review Owner-reviewed Product Data, Shop Drawings, and Samples, noting discrepancies and other issues in providing for Owner-furnished products in the Work.
3. Receive, unload, handle, store, protect, and install Owner-furnished products.
4. Make building services connections for Owner-furnished products.
5. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.
6. Repair or replace Owner-furnished products damaged following receipt.

C. Panel Signage, Egress signage, code compliant signage is owner furnished, contractor installed.

D. Food Service Equipment: All food service equipment will be Owner furnished, owner installed unless noted otherwise. All hardwired, ducted and plumbed connections for the Owner furnished equipment shall be in this contract. All items shown to be in wall, underslab, above ceiling shall be provided and installed under the contract. The UDS, Kitchen Hood and Cooler/Freezer (including condensers) shall be contractor furnished, contractor installed under this Conract. This contractor will be required to assist with coordination of delivery and installation of the Owner furnished equipment. Owner shall provide cut sheets on final equipment prior to ordering to assist with coordination.

1.8 CONTRACTOR'S USE OF SITE AND PREMISES

A. Restricted Use of Site: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

B. Limits on Use of Site: Limit use of Project site to Work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
1. Do not disturb more than 40 feet from building footprints and 5 feet from parking lots, roadways, sidewalks, utility right-of ways.
2. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.

    a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
    b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

D. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.9 COORDINATION WITH OCCUPANTS

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

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.

B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.

1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.10 WORK RESTRICTIONS

A. Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit work to between 7 a.m. to 6 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:

1. Notify Architect / Owner not less than two days in advance of proposed utility interruptions.
2. Obtain Owner's written permission before proceeding with utility interruptions.

D. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.

1. Notify Architect / Owner not less than two days in advance of proposed disruptive operations.
2. Obtain Owner's written permission before proceeding with disruptive operations.

E. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Owner's property is not permitted.

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

1.11 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.

C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

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

1.12 CLEANING AND MAINTENANCE

A. The Contractor shall broom sweep the work areas, once a week or more often as required by job conditions.

B. The Contractor shall not allow trash to accumulate and shall remove same from work areas at the close of the working day. All debris shall be disposed of off-site. Burning material on site will not be permitted.

C. The Contractor will be completely responsible for the final clean-up of the job. The Contractor is responsible for clean-up and trash removal on a daily basis and should make sure none of his trash is left on the jobsite upon his completion. Refer to Section 017700 "Closeout Procedures" for further details of final cleaning requirements.

D. The Contractor shall remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from interior and exterior surfaces of fixtures, hardware, finish surfaces and equipment furnished as part of his Contract, existing items included in the Work, and existing items indicated to remain prior to final inspection.

1.13 OWNER APPROVAL OF SUBCONTRACTORS AND PERSONNEL

A. The Contractor shall not employ any subcontractor, superintendent or workmen whose employment on the project is objectionable to the Owner or Architect/Engineer.

1.14 MATERIAL DELIVERY, STORAGE AND HANDLING

A. The Contractor supplying and delivering equipment or materials must provide personnel and equipment to unload these materials at the time they arrive on site, or make provisions for receiving and unloading the shipment for Contractor inventory purposes.

B. All materials shall be shipped and stored and handled in a manner that will afford protection and ensure their being in first-class condition at the time they are incorporated in the work. After installation, they shall be properly protected against damage ensure their being in first-class condition when the construction as a whole is completed and accepted by the Owner.

1.15 EXISTING CONDITIONS

A. The Contractor, subcontractors and material suppliers shall be responsible for inspecting all job conditions affecting the installation of an item and taking all field measurements required prior to fabrication of an item to insure that the item concerned will integrate properly with all adjacent materials and fit all other conditions as they exist or will exist in the finished construction. Work in connection with installation of an item shall be coordinated with all other affected work and trades. Sleeves, anchors, and other items that must be embodied in or that otherwise affect other portions of the work will be located and set while such portions of the work are in progress.

1.16 QUALITY OF WORK

A. All items shall be installed in a workmanlike manner in accordance with the best recognized practice in the field concerned. Manufactured items shall be installed in strict accordance with manufacturer's printed directions, specifications and/or recommendations for installation of highest quality. All working parts shall be properly adjusted after installation and left in perfect working order. Unless otherwise indicated, items exposed to weather or subject to flooding or wetting shall be installed so as to shed and not hold water. Items shall in all cases be installed plumb and true and/or in proper relation to surrounding materials.

B. All materials entering into the construction of the building covered by this Contract including but not limited to those mentioned below, shall be securely anchored and/or tied together in accordance with the best recognized practice in the field concerned whether shown, specified or not. Ties and anchors shall be best quality for the purpose. All veneers, finishes, and applied items shall be securely anchored and tied to the backing material. The purpose of this paragraph is that each and every piece of otherwise secured in place in a permanent manner that will permit expansion, contraction and other minor movements and normal use of the structure without structural features of the building becoming impaired and without any of its parts becoming loose.

C. Unless otherwise specifically mentioned, all anchors, bolts, screws, fittings, fillers, hardware, accessories, trim and other parts required for or in connection with an item of material to make a complete, serviceable, finished and first quality installation shall be furnished and installed as part of the item whether or not called for by the Specifications.

D. Should the Contractor's work require sealant to compete the 'finished product' appearance of any item he is installing, at the direction of the Architect, that Contractor shall furnish and install that sealant whether or not called for on plans or in specifications.

E. Unless otherwise specifically specified, all items and parts thereof that are made of steel, iron or other ferrous metal that are not galvanized, plated, or otherwise specified to be factory finished, shall be cleaned and painted with one shop coat of the best quality rust inhibitive metallic primer. After installation, all exposed metal connections and abrasions shall be touched up with the same materials as the shop coat and left in good condition for final finishing.

1.17 INSPECTIONS, TESTING AND SPECIAL INSPECTIONS

A. The Owner will hire inspectors, testing companies and special inspections. See 014000 for additional information and Contractor's responsibilities.

B. Office of State Engineers Inspections:
1. Substantial Completion Inspections: See 017700 "Closeout Procedures" for requirements.

1.18 PERMITS & LICENSES

A. The Office of State Engineer will issue the Building Permit.

B. The Contractor shall secure all temporary permits required for the project.

C. All contractors and sub-contractors shall be required to obtain City of Conway business licenses (at no cost to the Owner). The Owner shall pay for all taps associated with new utility lines as indicated.

D. NPDES Permit for Construction Activity
1. The Contractor is responsible for filing a "Notice of Intent" with the South Carolina Department of Health and Environmental Control (SCDHEC) for a National Pollutant Discharge Elimination System (NPDES) Permit under 40 CFR Part 122.
2. Permit application must be filed forty eight hours (48) prior to commencing construction activity.
3. The Contractor shall utilize Best Management Practices (BMP) to control sediment runoff from construction areas.
4. The Contractor shall sign the Contractor's Certification form included in Contracting Requirements of the specifications as a co-permittee for the NPDES permit for the project.
5. General Contractor and all sub-contractors shall sign the co-permittee.

1.19 JOB SIGN

A. Location of Job Sign shall be approved by Architect and Owner

B. Architect will provide digital copy of graphic to sign provider.

C. Sign shall be 8 feet by 8 feet constructed of painted exterior grade plywood supports and sign substrate of aluminum faced signboard or other approved substrate.

D. Ink shall be solvent based ink system, UV compatible ink.

E. Printing shall either be directly to approved substrate or to vinyl that will be adhered to signboard.

F. Sign shall remain in good condition during construction period. If sign shows extreme fading, rotting, or deterioration, contractor shall replace sign.

1.20 Tree Care and Maintenance Plan

A. The General Contractor shall engage a Consulting Arborist who is a member in good standing of the American Society of Consulting Arborists. The Consulting Arborist will:
   1. Conduct an initial inspection of the Landmark Live Oak near the existing pond at the start of the project and provide care recommendations to the General Contractor, CCU Project Manager, and CCU Arboretum Staff.
   2. Perform monthly visual inspections to monitor the tree's health.
   3. Recommend treatments or remedies for any issues that arise during the project.
   4. Submit written reports after each inspection, detailing findings and recommendations, to the General Contractor, CCU Project Manager, and CCU Arboretum Staff.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for unit prices.
B. Related Requirements:
   1. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.

1.3 DEFINITIONS

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

1.4 PROCEDURES

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

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

A. Unit Price No. 1: Removal of unsatisfactory soil and replacement with satisfactory soil material.

1. Description: Unsatisfactory soil excavation and disposal off-site and replacement with satisfactory fill material or engineered fill from off-site, as required, in accordance with Section 312000 "Earth Moving."
2. Unit of Measurement: 25 cubic yard (cubic meter) of soil excavated, based on in-place surveys of volume before and after removal.

B. Unit Price No. 2: Trench rock excavation and replacement with satisfactory soil material.

1. Description: Classified trench rock excavation and disposal off-site and replacement with satisfactory fill material or engineered fill from off-site, as required, in accordance with Section 312000 "Earth Moving."
2. Unit of Measurement: 50 cubic yard (cubic meter) of rock excavated, based on survey of in-place surveys volume of before and after removal.

C. Unit Price No. 3: Cutting and patching of concrete slabs-on-grade or asphalt paths.

1. Description: Cutting of new or existing concrete slabs-on-grade up to 6 inches (152 mm) thick, removal and excavation as required, and subsequent backfill, compaction, and patching of concrete in accordance with Section 017300 "Execution." not otherwise indicated in the Contract Documents.
2. Unit of Measurement: 10 square feet (square meters) of concrete removed.

D. Unit Price No. 4: Concrete sidewalks.

1. Description: Installing additional 4" thick concrete sidewalks including preparation of grade, joints, etc.
2. Unit of Measurement: 20 square feet (square meters) of concrete.

END OF SECTION 012200

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include, as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation, whether or not indicated as part of alternate.

B. Execute accepted alternates under the same conditions as other Work of the Contract.

C. Schedule: A Part 3 "Schedule of Alternates" Article is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Outdoor Seating Area

1. Base Bid: Outdoor Seating Area as indicated on Drawing A-001 Architectural Site Plan and CIVIL AND LANDSCAPE ". Area to receive sod and landscaping.
2. Alternate: Outdoor Seating Area as indicated on Drawing A-001 Architectural Site Plan and L105 and as specified in Section 321400 "Unit Pavers." Area to receive concrete sidewalk, concrete edge band, and unit pavers with modified landscaping and sod.

B. Alternate No. 2: Demolition and Abatement

1. Base Bid: Demolition and abatement of existing clubhouse as indicated on Drawing AD-101 and AD-102 and as specified in Section 024119 "Selective Demolition." will be completed under a separate contract with the Owner. Account for 3 months for abatement and demolition of the clubhouse before sitework in Phase 2 can begin.
2. Alternate: Include demolition and abatement of existing clubhouse as indicated on Drawing AD-101 and AD-102 and as specified in Section 024119 "Selective Demolition."

END OF SECTION 012300

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.
B. Related Requirements:

1. Document 002600 "Procurement Substitution Procedures" for requirements for substitution requests prior to award of Contract.
2. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

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

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use form provided in Project Manual.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.

b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

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

1.6 PROCEDURES

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

1.7 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. Requested substitution provides sustainable design characteristics that specified product provided for compliance with Green Globes requirements.
c. Substitution request is fully documented and properly submitted.
d. Requested substitution will not adversely affect Contractor's construction schedule.
e. Requested substitution has received necessary approvals of authorities having jurisdiction.
f. Requested substitution is compatible with other portions of the Work.
g. Requested substitution has been coordinated with other portions of the Work.
h. Requested substitution provides specified warranty.
i. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Not allowed unless otherwise indicated.
C. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
b. Requested substitution does not require extensive revisions to the Contract Documents.

c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
d. Requested substitution provides sustainable design characteristics that specified product provided for compliance with Green Globes requirements.
e. Substitution request is fully documented and properly submitted.
f. Requested substitution will not adversely affect Contractor's construction schedule.
g. Requested substitution has received necessary approvals of authorities having jurisdiction.
h. Requested substitution is compatible with other portions of the Work.
i. Requested substitution has been coordinated with other portions of the Work.
j. Requested substitution provides specified warranty.
k. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SUBSTITUTION REQUEST FORM

Project CCU PGA Golf Facility
Arch. Project No. 22.304.00

To Quackenbush Architects + Planners
1217 Hampton Street,
Columbia, South Carolina 29201

Email: bhaller@quackenbusharchitects.com
Attn Barb Haller, AIA
Phone 803.771.2999

Requested By _____

Contract For _____

Bid Date _____ **Substitution Request Date** _____

Section Name _____

Section No. _____ **Paragraph** _____

Related Dwgs. _____

Specified Product/Fabrication Method (List name/description; model no.; manufacturer)

_____

_____Required Information for

Specified Product Attached

- Point by Point Comparative Product Data ☐
- Test ☐
- Reports ☐
- Fabrication Drawings ☐
- Samples (Where Applicable) ☐

Proposed Product/Fabrication Method (List trade name/description; model no.; manufacturer)

_____

_____

Required Information for *Proposed* Product Attached

- Point by Point Comparative Product Data ☐
- Test ☐
- Reports ☐
- Fabrication Drawings ☐
- Samples (Where Applicable) ☐

Reason for Request

_____

_____

_____

_____

List of Related Changes/Modifications

_____

_____

_____

_____

Differences Between Proposed Substitution and Specified Product

_____

_____

_____

_____

Proposed Product/Fabrication Method Affects Other Parts of the Work **Yes ☐ No ☐ Explain:**

_____

_____

_____

_____

Proposed Product/Fabrication Method Affects the Construction Schedule **Yes ☐ No ☐ Explain:**

_____

_____

_____

_____

Undersigned Pays for Changes to the Building Design, including engineering and detailing costs Caused by the Requested Substitution **Yes ☐ No ☐ Explain:**

_____

_____

_____

_____

Attach Additional Sheets if Required

CERTIFICATE OF EQUAL PERFORMANCE AND ASSUMPTION OF LIABILITY FOR EQUAL PERFORMANCE

Undersigned certifies:

1. Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product, except as noted herein.
2. Qualifications of manufacturer, installer, and other specified parties meet the specified qualifications.
3. Same special warranty will be furnished for proposed substitution as for specified product.
4. Same maintenance service and source for replacement parts, as applicable, is available as that specified.
5. Proposed substitution does not affect dimensions and functional clearances, except as noted herein.

Submitted By _____

Signed _____

Firm _____

Address _____

Telephone _____

Fax _____

Signature shall be by person having authority to legally bind his firm to the above terms. Failure to provide legally binding signature will result in rejection of proposed substitution.

FOR QUACKENBUSH ARCHITECTS + PLANNERS USE ONLY

☐ Substitution Approved – Included in Addendum No._____

☐ Substitution Approved as Noted – Included in Addendum No._____

☐ Substitution Rejected – Use Specified Materials

☐ Substitution Request Received Too Late for Review Prior to Bid – Use Specified Materials

By_____ Date_____

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
B. Related Requirements:

1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
2. Section 013100 "Project Management and Coordination" for requirements for forms for contract modifications provided as part of web-based Project management software.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on web-based Project management software. (ASI – Architectural Supplemental Instructions)

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

    a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    c. Include costs of labor and supervision directly attributable to the change.

d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
e. Quotation Form: Use forms acceptable to Architect.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Architect.

1.5 ADMINISTRATIVE CHANGE ORDERS

A. Unit-Price Adjustment: See Section 012200 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.6 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on form included in Project Manual.

1.7 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
B. Related Requirements:
   1. Section 012200 "Unit Prices" for administrative requirements governing the use of unit prices.
   2. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
   3. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.
   4. Section 018113.53 "Sustainable Design Requirements - Green Globes" for administrative requirements governing submittal of cost breakdown information required for sustainable design documentation.

1.3 DEFINITIONS

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

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.

   1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
   2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
   3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:

    a. Project name and location.
    b. Owner's name.
    c. Owner's Project number.
    d. Name of Architect.
    e. Architect's Project number.
    f. Contractor's name and address.
    g. Date of submittal.

2. Arrange schedule of values consistent with format of AIA Document G703.
3. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:

    a. Related Specification Section or division.
    b. Description of the Work.
    c. Name of subcontractor.
    d. Name of manufacturer or fabricator.
    e. Name of supplier.
    f. Change Orders (numbers) that affect value.
    g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.

        1) Labor.
        2) Materials.
        3) Equipment.

4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

    a. Differentiate between items stored on-site and items stored off-site.

6. Overhead Costs, Separate Line Items: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
7. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
8. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
9. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect and paid for by Owner.

B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.

C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:

    a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and

related to the Work covered by the payment and subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.

G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule (preliminary if not final).
4. Products list (preliminary if not final).
5. Sustainable design action plans, including preliminary project materials cost data.
6. Schedule of unit prices.
7. Submittal schedule (preliminary if not final).
8. List of Contractor's staff assignments.
9. List of Contractor's principal consultants.
10. Copies of building permits.
11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
12. Initial progress report.
13. Report of preconstruction conference.

H. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.

    a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 017700 "Closeout Procedures."

2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

I. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.

2. Certification of completion of final punch list items.
3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
4. Updated final statement, accounting for final changes to the Contract Sum.
5. AIA Document G706.
6. AIA Document G706A.
7. AIA Document G707.
8. Evidence that claims have been settled.
9. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
10. Final liquidated damages settlement statement.
11. Proof that taxes, fees, and similar obligations are paid.
12. Waivers and releases.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings.
3. RFIs.
4. Digital project management procedures.
5. Web-based Project management software package.
6. Project meetings.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

C. Related Requirements:
1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.
4. Section 019113 "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

1.3 DEFINITIONS

A. BIM: Building Information Modeling.

B. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, in web-based Project software directory, and in prominent location inbuilt facility. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

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

1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and direction of Project coordinator to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

1.6 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
b. Coordinate the addition of trade-specific information to coordination drawingsin a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
f. Indicate required installation sequences.
g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms, showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:

a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
c. Fire-rated enclosures around ductwork.

7. Electrical Work: Show the following:

a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
c. Panel board, switchboard, switchgear, transformer, busway, generator, and motor-control center locations.
d. Location of pull boxes and junction boxes, dimensioned from column center lines.

8. Fire-Protection System: Show the following:

a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.

9. Review: Architect will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.

C. Coordination Drawing Process: Prepare coordination drawings in the following manner:

1. Schedule submittal and review of Fire Sprinkler, Plumbing, HVAC, and Electrical Shop Drawings to make required changes prior to preparation of coordination drawings.
2. Commence routing of coordination drawing files with HVAC Installer, who will provide drawing plan files denoting approved ductwork. HVAC Installer will locate ductwork and piping on a single layer, using orange color. Forward drawings to Plumbing Installer.
3. Plumbing Installer will locate plumbing and equipment on a single layer, using blue color.
4. Fire Sprinkler Installer will locate piping and equipment, using red color. Fire Sprinkler Installer shall forward drawing files to Electrical Installer.
5. Electrical Installer will indicate service and feeder conduit runs and equipment in green color. Electrical Installer shall forward drawing files to Communications and Electronic Safety and Security Installer.
6. Communications and Electronic Safety and Security Installer will indicate cable trays and cabling runs and equipment in purple color. Communications and Electronic Safety and Security Installer shall forward completed drawing files to Contractor.
7. Contractor shall perform the final coordination review. As each coordination drawing is completed, Contractor will meet with Architect to review and resolve conflicts on the coordination drawings.

D. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:

1. File Preparation Format:

    a. Same digital data software program, version, and operating system as original Drawings.
    b. DWG, Version 2020, operating in Microsoft Windows operating system.

2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format and PDF format.
3. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.

    a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
    b. Digital Data Software Program: Drawings are available in AutoCAD 2020.
    c. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.

1.7 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Owner name.
3. Owner's Project number.
4. Name of Architect.
5. Architect's Project number.
6. Date.
7. Name of Contractor.
8. RFI number, numbered sequentially.
9. RFI subject.
10. Specification Section number and title and related paragraphs, as appropriate.
11. Drawing number and detail references, as appropriate.
12. Field dimensions and conditions, as appropriate.
13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
14. Contractor's signature.

15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.

1. Attachments shall be electronic files in PDF format.

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for approval of Contractor's means and methods.
    d. Requests for coordination information already indicated in the Contract Documents.
    e. Requests for adjustments in the Contract Time or the Contract Sum.
    f. Requests for interpretation of Architect's actions on submittals.
    g. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."

    a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 5 days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Use software log that is part of web-based Project management software.

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number, including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.
8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within three days if Contractor disagrees with response.

1.8 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Architect's Data Files Not Available: Architect will not provide Architect's BIM model digital data files for Contractor's use during construction.

B. Use of Architect's Digital Data Files: Digital data files of Architect's CAD drawings will be provided by Architect for Contractor's use during construction.

1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.
2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
3. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.

    a. Subcontractors and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of Agreement acceptable to Owner and Architect.

4. The following digital data files will be furnished for each appropriate discipline:

    a. Floor plans.
    b. Reflected ceiling plans.

C. Web-Based Project Management Software Package: Provide, administer, and use web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion.

1. Web-based Project management software includes, at a minimum, the following features:

    a. Compilation of Project data, including Contractor, subcontractors, Architect, Architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
    b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
    c. Document workflow planning, allowing customization of workflow between project entities.
    d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
    e. Track status of each Project communication in real time, and log time and date when responses are provided.

f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
g. Processing and tracking of payment applications.
h. Processing and tracking of contract modifications.
i. Creating and distributing meeting minutes.
j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
k. Management of construction progress photographs.
l. Mobile device compatibility, including smartphones and tablets.

2. Provide up to seven Project management software user licenses for use of Owner, Owner's Commissioning Authority, Architect, and Architect's consultants. Provide eight hours of software training at Architect's office for web-based Project software users.
3. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Architect. Provide data in locked format to prevent further changes.
4. 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. Autodesk, Inc.
b. Deltek Inc.
c. Procore Technologies, Inc.

D. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:

1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.9 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of seven days prior to meeting.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

B. Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.

1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:

    a. Responsibilities and personnel assignments.
    b. Tentative construction schedule.
    c. Phasing.
    d. Critical work sequencing and long lead items.
    e. Designation of key personnel and their duties.
    f. Lines of communications.
    g. Use of web-based Project software.
    h. Procedures for processing field decisions and Change Orders.
    i. Procedures for RFIs.
    j. Procedures for testing and inspecting.
    k. Procedures for processing Applications for Payment.
    l. Distribution of the Contract Documents.
    m. Submittal procedures.
    n. Sustainable design requirements.
    o. Preparation of Record Documents.
    p. Use of the premises and existing building.
    q. Work restrictions.
    r. Working hours.
    s. Owner's occupancy requirements.
    t. Responsibility for temporary facilities and controls.
    u. Procedures for moisture and mold control.
    v. Procedures for disruptions and shutdowns.
    w. Construction waste management and recycling.
    x. Parking availability.
    y. Office, work, and storage areas.
    z. Equipment deliveries and priorities.
    aa. First aid.
    bb. Security.
    cc. Progress cleaning.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Sustainable Design Requirements Coordination Conference: Architect will schedule and conduct a sustainable design coordination conference before starting construction, at a time convenient to Owner Architect, and Contractor.

1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent and sustainable design

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

2. Agenda: Discuss items of significance that could affect meeting sustainable design requirements, including the following:

    a. Sustainable design Project checklist.
    b. General requirements for sustainable design-related procurement and documentation.
    c. Project closeout requirements and sustainable design certification procedures.
    d. Role of sustainable design coordinator.
    e. Construction waste management.
    f. Construction operations and sustainable design requirements and restrictions.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

D. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, and Owner's Commissioning Authority of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

    a. Contract Documents.
    b. Options.
    c. Related RFIs.
    d. Related Change Orders.
    e. Purchases.
    f. Deliveries.
    g. Submittals.
    h. Sustainable design requirements.
    i. Review of mockups.
    j. Possible conflicts.
    k. Compatibility requirements.
    l. Time schedules.
    m. Weather limitations.
    n. Manufacturer's written instructions.
    o. Warranty requirements.
    p. Compatibility of materials.
    q. Acceptability of substrates.
    r. Temporary facilities and controls.
    s. Space and access limitations.
    t. Regulations of authorities having jurisdiction.
    u. Testing and inspecting requirements.
    v. Installation procedures.

w. Coordination with other work.
x. Required performance results.
y. Protection of adjacent work.
z. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

E. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.
2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

a. Preparation of Record Documents.
b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
c. Procedures for completing and archiving web-based Project software site data files.
d. Submittal of written warranties.
e. Requirements for completing sustainable design documentation.
f. Requirements for preparing operations and maintenance data.
g. Requirements for delivery of material samples, attic stock, and spare parts.
h. Requirements for demonstration and training.
i. Preparation of Contractor's punch list.
j. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
k. Submittal procedures.
l. Coordination of separate contracts.
m. Owner's partial occupancy requirements.
n. Installation of Owner's furniture, fixtures, and equipment.
o. Responsibility for removing temporary facilities and controls.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

F. Progress Meetings: Conduct progress meetings at biweekly intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

    a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

        1) Review schedule for next period.

    b. Review present and future needs of each entity present, including the following:

        1) Interface requirements.
        2) Sequence of operations.
        3) Resolution of BIM component conflicts.
        4) Status of submittals.
        5) Status of sustainable design documentation.
            a) Include full updates at 25%, 50% and substantial completion.
        6) Deliveries.
        7) Off-site fabrication.
        8) Access.
        9) Site use.
        10) Temporary facilities and controls.
        11) Progress cleaning.
        12) Quality and work standards.
        13) Status of correction of deficient items.
        14) Field observations.
        15) Status of RFIs.
        16) Status of Proposal Requests.
        17) Pending changes.
        18) Status of Change Orders.
        19) Pending claims and disputes.
        20) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

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

G. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

    a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
    b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
    c. Review present and future needs of each contractor present, including the following:

        1) Interface requirements.
        2) Sequence of operations.
        3) Status of submittals.
        4) Deliveries.
        5) Off-site fabrication.
        6) Access.
        7) Site use.
        8) Temporary facilities and controls.
        9) Work hours.
        10) Hazards and risks.
        11) Progress cleaning.
        12) Quality and work standards.
        13) Status of RFIs.
        14) Proposal Requests.
        15) Change Orders.
        16) Pending changes.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Startup construction schedule.
2. Contractor's Construction Schedule.
3. Construction schedule updating reports.
4. Daily construction reports.
5. Material location reports.
6. Site condition reports.
7. Unusual event reports.

B. Related Requirements:
1. Section 012900 "Payment Procedures" for schedule of values and requirements for use of cost-loaded schedule for Applications for Payment.
2. Section 014000 "Quality Requirements" for schedule of tests and inspections.

1.2 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.
C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.
D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
E. Event: The starting or ending point of an activity.
F. Float: The measure of leeway in starting and completing an activity.

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. Resource Loading: The allocation of labor and equipment necessary for completing an activity as scheduled.

1.3 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:
   1. PDF file.

B. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports to contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

   1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
   2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
   3. Total Float Report: List of activities sorted in ascending order of total float.

E. Construction Schedule Updating Reports: Submit with Applications for Payment.
F. Daily Construction Reports: Submit at weekly intervals.
G. Material Location Reports: Submit at monthly intervals.
H. Site Condition Reports: Submit at time of discovery of differing conditions.
I. Unusual Event Reports: Submit at time of unusual event.

1.4 QUALITY ASSURANCE

A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures

related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including phasing area and partial Owner occupancy.
4. Review delivery dates for Owner-furnished products.
5. Review schedule for work of Owner's separate contracts.
6. Review submittal requirements and procedures.
7. Review time required for review of submittals and resubmittals.
8. Review requirements for tests and inspections by independent testing and inspecting agencies.
9. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
10. Review and finalize list of construction activities to be included in schedule.
11. Review procedures for updating schedule.

1.5 COORDINATION

A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities, and schedule them in proper sequence.

1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Final Completion.

1. Contract completion date to not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

B. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
2. Temporary Facilities: Indicate start and completion dates for the following as applicable:

    a. Securing of approvals and permits required for performance of the Work.
    b. Temporary facilities.
    c. Construction of mock-ups, prototypes and samples.
    d. Owner interfaces and furnishing of items.
    e. Interfaces with Separate Contracts.

f. Regulatory agency approvals.
g. Punch list.

3. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
4. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
5. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
6. Commissioning Time: Include no fewer than 15 days for commissioning.
7. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
8. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.

C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Phasing: Arrange list of activities on schedule by phase.
2. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
3. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
4. Work Restrictions: Show the effect of the following items on the schedule:

a. Coordination with existing construction.
b. Limitations of continued occupancies.
c. Uninterruptible services.
d. Partial occupancy before Substantial Completion.
e. Use-of-premises restrictions.
f. Provisions for future construction.
g. Seasonal variations.
h. Environmental control.

5. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:

a. Subcontract awards.
b. Submittals.
c. Purchases.
d. Mockups.
e. Fabrication.
f. Sample testing.
g. Deliveries.
h. Installation.

i. Tests and inspections.
j. Adjusting.
k. Curing.
l. Building flush-out.
m. Startup and placement into final use and operation.
n. Commissioning.

6. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

a. Structural completion.
b. Temporary enclosure and space conditioning.
c. Permanent space enclosure.
d. Completion of mechanical installation.
e. Completion of electrical installation.
f. Substantial Completion.

D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion, and the following interim milestones:

1. Temporary enclosure and space conditioning.

E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the Work and the Contract Time.

F. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Final Completion percentage for each activity.

G. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

H. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.7 GANTT-CHART SCHEDULE REQUIREMENTS

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for the Notice to Proceed.

1. Base schedule on the startup construction schedule and additional information received since the start of Project.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

1.8 CPM SCHEDULE REQUIREMENTS

A. Prepare network diagrams using AON (activity-on-node) format.
B. CPM Schedule: Prepare Contractor's Construction Schedule using a time-scaled CPM network analysis diagram for the Work.

1. Develop network diagram in sufficient time to submit CPM schedule, so it can be accepted for use no later than 60 days after date established for the Notice to Proceed.

a. Failure to include any work item required for performance of this Contract must not excuse Contractor from completing all work within applicable completion dates.

2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.

C. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:

    a. Preparation and processing of submittals.
    b. Mobilization and demobilization.
    c. Purchase of materials.
    d. Delivery.
    e. Fabrication.
    f. Utility interruptions.
    g. Installation.
    h. Work by Owner that may affect or be affected by Contractor's activities.
    i. Testing and inspection.
    j. Commissioning.
    k. Punch list and Final Completion.
    l. Activities occurring following Final Completion.

2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates to be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.

    a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

D. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.

E. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:

1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Main events of activity.
4. Immediate preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.
9. Average size of workforce.
10. Dollar value of activity (coordinated with the schedule of values).

F. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:

1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

1.9 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Testing and inspection.
8. Accidents.
9. Meetings and significant decisions.
10. Unusual events.
11. Stoppages, delays, shortages, and losses.
12. Meter readings and similar recordings.
13. Emergency procedures.
14. Orders and requests of authorities having jurisdiction.
15. Change Orders received and implemented.
16. Construction Change Directives received and implemented.
17. Services connected and disconnected.
18. Equipment or system tests and startups.
19. Partial completions and occupancies.
20. Substantial Completions authorized.

B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List to be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:

1. Material stored prior to previous report and remaining in storage.
2. Material stored prior to previous report and since removed from storage and installed.
3. Material stored following previous report and remaining in storage.

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

D. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

1. Submit unusual event reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 013200

SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Preconstruction photographs.
2. Concealed Work photographs.
3. Periodic construction photographs.
4. Preconstruction video recordings.
5. Periodic construction video recordings.

B. Related Requirements:

1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
2. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
3. Section 024119 "Selective Demolition" for photographic documentation before selective demolition operations commence.

1.2 INFORMATIONAL SUBMITTALS

A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.

B. Digital Photographs: Submit image files within three days of taking photographs.

1. Submit photos by uploading to web-based Project management software site. Include copy of key plan indicating each photograph's location and direction.
2. Identification: Provide the following information with each image description in web-based Project management software site:

a. Name of Project.
b. Name and contact information for photographer.
c. Name of Architect.
d. Name of Contractor.
e. Date photograph was taken.
f. Description of location, vantage point, and direction.
g. Unique sequential identifier keyed to accompanying key plan.

C. Video Recordings: Submit video recordings within seven days of recording.

1. Submit video recordings by uploading to web-based Project management software site. Include copy of key plan indicating each video's location and direction.
2. Identification: With each submittal, provide the following information on web-based Project management software site:

    a. Name of Project.
    b. Name and contact information for photographer.
    c. Name of Architect.
    d. Name of Contractor.
    e. Date video recording was recorded.
    f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

1.3 FORMATS AND MEDIA

A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels. Use flash in low light levels or backlit conditions.
B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full high-definition mode. Provide supplemental lighting in low light levels or backlit conditions.
C. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
D. Metadata: Record accurate date and timefrom camera.
E. File Names: Name media files with date Project area and sequential numbering suffix.

1.4 CONSTRUCTION PHOTOGRAPHS

A. Photographer: Engage a qualified photographer to take construction photographs.
B. General: Take photographs with maximum depth of field and in focus.

    1. Maintain key plan with each set of construction photographs that identifies each photographic location.

C. Preconstruction Photographs: Before commencement of the Work, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.

    1. Flag excavation areas before taking construction photographs.
    2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
    3. Aerial photographs / Drone photographs of site area.

4. Take 20 photographs of existing buildings either on or adjoining property, to accurately record physical conditions at start of construction.
5. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

D. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work, including, but not limited to, the following:

1. Underground utilities.
2. Underslab services.
3. Piping.
4. Electrical conduit.
5. Waterproofing and weather-resistant barriers.

E. Periodic Construction Photographs: Take 20 photographs weekly. Select vantage points to show status of construction and progress since last photographs were taken. Include a minimum of 3-4 aerial / drone photographs monthly or at major milestones of construction.

F. Final Completion Construction Photographs: Take 20 photographs after date of Substantial Completion for submission as Project Record Documents. Architect will inform photographer of desired vantage points.

G. Additional Photographs: Architect may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.

1. Three days' notice will be given, where feasible.
2. In emergency situations, take additional photographs within 24 hours of request.
3. Circumstances that could require additional photographs include, but are not limited to, the following:

a. Special events planned at Project site.
b. Immediate follow-up when on-site events result in construction damage or losses.
c. Photographs are to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
d. Substantial Completion of a major phase or component of the Work.
e. Extra record photographs at time of final acceptance.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 013233

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
4. Section 013233 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and Final Completion construction photographs.
5. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
6. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
7. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
8. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
9. Section 018113.53 "Sustainable Design Requirements - Green Globes" for sustainable design submittals.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.

    a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

    a. Scheduled date for first submittal.
    b. Specification Section number and title.
    c. Submittal Category: Action; informational.
    d. Name of subcontractor.
    e. Description of the Work covered.
    f. Scheduled date for Architect's final release or approval.
    g. Scheduled date of fabrication.
    h. Scheduled dates for installation.
    i. Activity or event number.

1.4 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
8. Category and type of submittal.
9. Submittal purpose and description.
10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
11. Drawing number and detail references, as appropriate.

12. Indication of full or partial submittal.
13. Location(s) where product is to be installed, as appropriate.
14. Other necessary identification.
15. Remarks.
16. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Paper Submittals:

1. Place a permanent label or title block on each submittal item for identification; include name of firm or entity that prepared submittal.
2. Provide a space approximately 6 by 8 inches (150 by 200 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
3. Action Submittals: Submit three paper copies of each submittal unless otherwise indicated. Architect will return two copies.
4. Informational Submittals: Submit two paper copies of each submittal unless otherwise indicated. Architect will not return copies.
5. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
6. Transmittal for Submittals: Assemble each submittal individually and appropriately for transmittal and handling.

E. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

F. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

1.5 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.
2. Paper: Prepare submittals in paper form and deliver to Architect.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.
4. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.

    a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.6 SUBMITTAL REQUIREMENTS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

a. Manufacturer's catalog cuts.
b. Manufacturer's product specifications.
c. Standard color charts.
d. Statement of compliance with specified referenced standards.
e. Testing by recognized testing agency.
f. Application of testing agency labels and seals.
g. Notation of coordination requirements.
h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

a. Wiring diagrams that show factory-installed wiring.
b. Printed performance curves.
c. Operational range diagrams.
d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

a. Identification of products.
b. Schedules.
c. Compliance with specified standards.
d. Notation of coordination requirements.
e. Notation of dimensions established by field measurement.
f. Relationship and attachment to adjoining construction clearly indicated.
g. Seal and signature of professional engineer if specified.

2. Paper Sheet Size: Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm), but no larger than 30 by 42 inches (750 by 1067 mm).
a. Three opaque copies of each submittal. Architect will retain two copies; remainder will be returned.

C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.

1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
2. Identification: Permanently attach label on unexposed side of Samples that includes the following:

    a. Project name and submittal number.
    b. Generic description of Sample.
    c. Product name and name of manufacturer.
    d. Sample source.
    e. Number and title of applicable Specification Section.
    f. Specification paragraph number and generic name of each item.
3. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
4. Paper Transmittal: Include paper transmittal, including complete submittal information indicated.
5. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

    a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.

    a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

    a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.

1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.

E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests

performed before installation of product. Include written recommendations for substrate preparation and primers required.

2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

    a. Name of evaluation organization.
    b. Date of evaluation.
    c. Time period when report is in effect.
    d. Product and manufacturers' names.
    e. Description of product.
    f. Test procedures and results.
    g. Limitations of use.

1.7 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.8 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp and indication in web-based Project management software. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S REVIEW

A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return.

1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action.
2. Paper Submittals: Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
3. Submittals by Web-Based Project Management Software: Architect will indicate, on Project management software website, the appropriate action.

B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
E. Architect will discard submittals received from sources other than Contractor.
F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

SECTION 013546 – INDOOR AIR QUALITY TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Indoor Environmental Consultant qualifications.
2. Indoor air quality testing.
3. Documentation and reporting.

1.2 REFERENCES

A. United States Environmental Protection Agency (EPA):

1. Compendium of Methods for the Determination of Air Pollutants in Indoor Air.
2. National Ambient Air Quality Standard, Code of Federal Regulations, Title 40, Part 50.

B. The Green Building Initiative:

1. Green Globes for New Construction 2021 – Technical Reference Manual

1.3 DEFINITIONS

A. Threshold Limit Value (TLV): Industrial Workplace Standard as defined by ACGIH.

B. Green Globes Assessor: Third Party verification professional assigned by the GBI to review and verify compliance with Green Globes requirements.

1.4 SUBMITTALS

A. Indoor Air Quality Testing Plan

1. Provide Copies of an Indoor Air Quality Testing Plan from the Indoor Environment Consultant that highlights compliance with Green Globes NC 2021 6.2.2.1A Path A: Indoor Air Quality (IAQ) Pre-Occupancy Testing, or equivalent testing that has been approved by the Project's Green Globes Assessor.
2. Include in Report:
    a. Equipment to be used in testing
    b. Sampling plan including marked up drawings highlighting areas to be tested.
    c. Overview of analytical methods to be employed.

B. Indoor Air Quality Test Report

1. Provide Copies of Indoor Air Quality Test Report from Indoor Environmental Consultant.
2. Include in Report:

a. Study design including methodology for determination of air sampling locations and duration of sampling.

b. Summary of sampling and analytical methods employed.

c. Copy of field sampling logs.

d. Summary of methods and results used to determine that ventilation system was started at normal daily start time and operated at minimum outside airflow rates for occupied mode for duration of air testing.

e. Laboratory analytical data for each contaminant and summary table showing compliance with specified criteria.

1.5 QUALITY ASSURANCE

A. Indoor Environmental Consultant:

1. Contractor will employ and pay for an Indoor Environmental Consultant to perform specified indoor air quality testing.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 INDOOR AIR QUALITY TESTING REQUIREMENTS

A. Provide Indoor Air Quality Test(s) that are compliant with the requirements of Green Globes NC 2021 6.2.2.1A Path A: Indoor Air Quality (IAQ) Pre-Occupancy Testing, or equivalent testing that has been approved by the Project's Green Globes Assessor and will result in 6 of 6 available points under that category.

B. For each sampling location where maximum concentration limit is exceeded, conduct additional flush-out with outside air and retest specific contaminant until maximum concentration limit is achieved. Collect samples for retesting from original sampling location.

3.2 INDOOR AIR QUALITY TESTING PROCEDURES AND SAMPLING

A. The testing takes place after construction ends and prior to occupancy.

B. The test protocols are in accordance with the following:

1. The VOC and Particulate Matter sampling and averaging times and measurement methods achieve the detection limits of the contaminant levels listed in Green Globes Table #11.2.2A.1: Maximum Level of Contaminants

2. HVAC systems are operated at the minimum design outdoor air ventilation rate during testing;

3. Air sampling and monitoring are at a height of 3-6 ft. (91-183 cm) from the floor and at least 3 ft. (0.9 m) away from walls and ventilation supply;

4. The test protocols are documented to show that appropriate sampling methods and times were used; and

5. The number of sampling locations are as follows for each portion of the building served by a separate ventilation system:
    a. At least one per contiguous floor; and
    b. At least one per 10,000 ft.2 (929 m2) of floor area.
6. The sampling points shall include areas presumed to have the greatest source strength with the least ventilation.

END OF SECTION 013546

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

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

1.2 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.

1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.

1. Mockups are used for one or more of the following:

a. Verify selections made under Sample submittals.

b. Demonstrate aesthetic effects.
c. Demonstrate the qualities of products and workmanship.
d. Demonstrate successful installation of interfaces between components and systems.
e. Perform preconstruction testing to determine system performance.

2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.

E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) in accordance with 29 CFR 1910.7, by a testing agency accredited in accordance with NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."

I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.3 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in

compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.4 CONFLICTING REQUIREMENTS

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

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

1.5 ACTION SUBMITTALS

A. Mockup Shop Drawings:

1. Include plans, sections, elevations, and details, indicating materials and size of mockup construction.
2. Indicate manufacturer and model number of individual components.
3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.6 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
2. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.

D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

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

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

F. Reports: Prepare and submit certified written reports and documents as specified.

G. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner's quality-assurance and quality-control activities. Coordinate with Contractor's Construction Schedule.

B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

1. Project quality-control manager may also serve as Project superintendent.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by Commissioning Authority.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports, including log of approved and rejected results. Include Work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, telephone number, and email address of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement of whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement of whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

1.9 QUALITY ASSURANCE

A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.

1. Requirements of authorities having jurisdiction supersede requirements for specialists.

G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor's Responsibilities:

    a. Provide test specimens representative of proposed products and construction.
    b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
    c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
    d. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
    e. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Commissioning Authority, with copy to Contractor. Interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups of size indicated.
2. Build mockups in location indicated or, if not indicated, as directed by Architect.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
5. Demonstrate the proposed range of aesthetic effects and workmanship.
6. Obtain Architect's approval of mockups before starting corresponding Work, fabrication, or construction.

    a. Allow seven days for initial review and each re-review of each mockup.

7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
10. Demolish and remove mockups when directed unless otherwise indicated.

L. Specialty Mockups: See Section 014339 "Mockups" for additional construction requirements for integrated exterior mockups.

1.10 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be withheld from the Contrator's pay-app.

B. Contractor Responsibilities: Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.

2. Notify testing agencies at least two-business days in advance of time when Work that requires testing or inspection will be performed.
3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
4. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

D. Testing Agency Responsibilities: Cooperate with Architect, Commissioning Authority and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect, Commissioning Authority, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform duties of Contractor.

E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspection equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payment.

1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
2. Distribution: Distribute schedule to Owner, Architect, Commissioning Authority, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.11 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency / special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated in the Statement of Special Inspections attached to this Section, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures, and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect, Commissioning Authority, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect and Commissioning Authority with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

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

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's, Commissioning Authority's, and authorities' having jurisdiction reference during normal working hours.

1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

Seismic Requirements - Quality Assurance Plan

1) Seismic Force Resisting Systems

    a) Reinforced masonry walls and associated foundations
    b) Roof deck and floor deck and elevated slabs.
    c) Concrete basement walls.

2) Additional Systems and Structures

    a) Anchorage of electrical equipment used for emergency or stand-by power systems.

3) Special inspections and testing for the seismic force resisting systems and additional systems and structures above are specified in "Schedule of Special Inspections".

4) The type and frequency of special inspections required are specified in the "Schedule of Special Inspections".

5) Testing and special inspection reports shall be distributed weekly to the Architect, Contractor, Owner, and Structural Engineer.

Contractor's Statement of Responsibility
Seismic Quality Assurance

To be completed by the General Contractor and every Subcontractor responsible for the construction of designated systems and components listed in the Seismic Quality Assurance Plan. Submit separate copies to the Building Official and the Owner.

Project Name: PGA Golf Facility
Owner: Coastal Carolina University

A Seismic Quality Assurance Plan has been defined for this project. The required Seismic Quality Assurance program entitled "Quality Assurance Plan for Seismic Resistance" is an attachment to Section 014000 – Quality Requirements of the Project Specifications. The program designates building elements covered and references requiring Special Inspections that are part of the Seismic Quality Assurance Plan.

As a Contractor responsible for the construction of the designated systems and components listed in the quality assurance plan, I acknowledge the following:

1. We acknowledge awareness of the special requirements contained in the quality assurance plan.
2. We acknowledge that control will be exercised to obtain conformance with the construction documents approved by the Office of State Engineer (OSE).
3. Procedures will be maintained for exercising control within our organization to ensure compliance for the method and frequency of reporting, and for the distribution of the reports. (Attach description of the procedures to be instituted.)
4. Person(s) in our organization exercising control of the quality assurance plan requirements and their qualifications are identified in the attachment provided. (Attach list of personnel with qualifications.)

Submitted by:

_____
(Type or Print Name of Firm)

_____
(Type or Print Name of Firm Owner, Partner or Corp. Sec.)

_____
Signature Date

Owner's Authorization:

_____
Signature Date

STATEMENT OF SPECIAL INSPECTIONS

Project Name: PGA Golf Facility
Owner: Coastal Carolina University

Architect/Engineer: Quackenbush Architects + Planners/ Weatherly Structural Engineers

The following firms and/or individuals are designated to perform the Special Inspections of the material or work designated below. (*Ex: Foundations, Concrete, etc.)* The firms and/or individuals have the experience, qualifications, certifications and/or licenses required to perform the special inspections indicated.

Material/Work to be Inspected: Soils
Firm/Individual Name: TBD
Address: TBD

Material/Work to be Inspected: Concrete
Firm/Individual Name: TBD
Address: TBD

Material/Work to be Inspected: Masonry
Firm/Individual Name: TBD
Address: TBD

Material/Work to be Inspected: Structural Steel, Steel Deck, Light Gage Framing
Firm/Individual Name: TBD
Address: TBD

Responsibilities of the special inspectors are indicated on the attached Schedule of Special Inspections. Discrepancies shall be brought to the immediate attention of the Contractor so that corrective action can be taken in a timely manner. Copies of all test reports and test data shall be obtained from the inspectors by the A/E on a timely basis.

_____
(Print or Type Name of A/E Representative)

_____ _____
(Signature) *(Date)*

STATEMENT OF SPECIAL INSPECTIONS

Project Name: PGA Golf Facility
Owner: Coastal Carolina University

Architect/Engineer: Quackenbush Architects + Planners/ RMF Engineering

The following firms and/or individuals are designated to perform the Special Inspections of the material or work designated below. The firms and/or individuals have the experience, qualifications, certifications and/or licenses required to perform the special inspections indicated.

Material/Work to be Inspected: Mechanical & Plumbing & Electrical & Fire Protection Components

Firm/Individual Name: TBD
Address: TBD

Material/Work to be Inspected: Electrical Components

Firm/Individual Name: TBD
Address: TBD

Responsibilities of the special inspectors are indicated on the attached Schedule of Special Inspections. Discrepancies shall be brought to the immediate attention of the Contractor so that corrective action can be taken in a timely manner. Copies of all test reports and test data shall be obtained from the inspectors by the A/E on a timely basis.

_____
(Print or Type Name of A/E Representative)

_____ _____
(Signature) *(Date)*

SCHEDULE OF SPECIAL INSPECTIONS (4 Pages)

Project Name: PGA Golf Facility
Owner: Coastal Carolina University

Special Inspection requirements based on Section 1705 of Chapter 17 of the 2018 International Building Code and Chapter 1 of the 2018 International Building Code

MATERIALS	TYPE OF INSPECTION	SPECIFICATION OR CODE REFERENCE	INSPECTION BY		
			ARCH	***ENG***	***Testing Company***
Soils - Subgrade	Compaction Once per 2500 cubic yard	Specification 312000 &312333			TBD
SABC	Sieve Analysis for each layer	Specification 312000 &312333			TBD
SABC	Compaction after placement	Specification 312000 &312333			TBD
Soil Fill	Suitability & Compaction, each source	Specification 312000 &312333			TBD
Concrete (sitework)	Mix design/ slump, 30 days prior to work	Specification 321313			TBD
	Cylinder Compressive strength test-ing	Specification 323113			TBD
Soils	Site Preparation	See Site Prep Notes on S-000			TBD
	Fill Placement	See Site Prep Notes on S-000			TBD
	In-Place Density	See Site Prep Notes on S-000			TBD
	Footing Bottoms	See Site Prep Notes on S-000			TBD
	Proof-roll of subgrade	Specification 312000			TBD
	Fill Compaction	Specification 312000			TBD
	Trench Backfill Compaction	Specification 312000			TBD
Concrete	Rebar Placement (Periodic)	Specification 033000			TBD
	Verify use of Design Mix (Periodic)	Specification 033000			TBD
	Sample Slump, air, temp. strength (Cont)	Specification 033000			TBD
	Concrete Placement (Cont)	Specification 033000			TBD
	Curing (Periodic)	Specification 033000			TBD
Paving	Monitor Asphalt Placement and Compaction	Specification 321216			TBD
Site Water Main	Pressure Testing	Specification 331100			TBD

MATERIALS	TYPE OF INSPECTION	SPECIFICATION OR CODE REFERENCE	INSPECTION BY		
			ARCH	*ENG*	*Testing Company*
Masonry	Periodic Verification:				TBD
	a) Site mixed mortar	Specification 042200			
	b) Mortar joint placement	Specification 042200			
	c) Mortar joint construction	Specification 042200			
	d) Rebar location	Specification 042200			
	e) Rebar placement	Specification 042200			
	f) Clean grout space	Specification 042200			
	g) Site mixed grout	Specification 042200			
	Periodic Inspection:				TBD
	a) Size & location of structural elements	Specification 042200			TBD
	b) Type & location of anchors	Specification 042200			TBD
	c) Size & Type of reinforcing	Specification 042200			TBD
	d) Cold/hot weather protection	Specification 042200			TBD
	Verification of grout placement (continuous)	Specification 042200			TBD
	Preparation of grout & mortar specimens (continuous)	Specification 042200			TBD
	Compliance with inspections and submittals (Periodic)	Specification 042200			TBD
Structural Steel	Verification of high-strength bolts/washers (Periodic)	Specification 051200			TBD
	Inspection of high-strength bolts/washers (Periodic)	Specification 051200			TBD
	Verification of structural steel materials	Specification 051200			TBD
	Verification of weld filler mat'ls	Specification 051200			TBD
	Inspection of Structural Steel Welding:				TBD
	Single-pass <5/16" (Periodic)	Specification 051200			TBD
	Single-pass >5/16" (Cont.)	Specification 051200			TBD
	Periodic Inspection of Steel Frame Joints	Specification 051200			TBD
Structural Steel	Inspection of shear connectors	Specification 051200			TBD
Cold Formed Metal Framing		Specification 054000			
Cold Form Trusses		Specification 054400			TBD

MATERIALS	TYPE OF INSPECTION	SPECIFICATION OR CODE REFERENCE	INSPECTION BY		
			ARCH	*ENG*	*Testing Company*
Steel Deck	Inspection of roof deck attachments (Periodic)	Specification 053100			TBD
Light Gage Framing	Inspection of member sizes and spacings (Periodic)	Specification 054000			TBD
	Inspection of member connections and bridging (Periodic)	Specification 054000			TBD
Suspended Ceiling Systems	Review Submittal	Division 9 ceiling systems	X		
	Inspection of installation and anchorage of suspension system (Periodic)	Division 9 ceiling systems			
Sprayed fire-resistant materials	Inspection for sprayed fire-resistant materials applied to structural elements and decks	Specification 078116, International Building Code 2018 – 1705.14			TBD
Fire Resistance Penetration & Joint Inspections	Inspection of joint and penetration protection required by IBC 714 and IBC 715 before concealed from view	International Building Code 2018 – 110.3.7 & 1705.17.1 & 1705.17.2			TBD
Footing & Foundation inspections	Inspection after excavation for footing of reinforcing steel and any formwork	International Building Code 2018 - 110.3.1			TBD
Concrete slab & under floor inspection	Inspection after in-slab or under-floor reinforcing and building service equipment, conduit, piping, etc are in place, but prior to concrete placement	International Building Code 2018 - 110.3.2			TBD
Frame Inspections	Inspection of framing and items that will be concealed	International Building Code 2018 - 110.3.4			TBD
Gypsum Board Inspection	Inspection of gypsum board prior to plaster, taping and finishing	International Building Code 2018 - 110.3.5			TBD

MATERIALS	TYPE OF INSPECTION	SPECIFICATION OR CODE REFERENCE	INSPECTION BY		
			ARCH	*ENG*	*Testing Company*
Energy Efficiency Inspections	Inspection to determine compliance with IBC Chapter 13	International Building Code 2018 - 110.3.8			TBD
	a) Envelope Insulation (R-Value)	Specification 071200	x		
	b) Fenestration U-Value	Specification 088000	x		
	c) Duct System R-Value	Specification 230700		x	
	d) HVAC & Water Heating Equipment efficiency	Equipment Schedules on Drawings		x	
Air Barrier	Inspection to determine compliance with 072726 specification	Specification 072726			TBD
Mechanical Inspections	Rough-in inspection prior to wall or ceiling membranes	International Mechanical Code 2018 - 107.2			TBD
	Wind restraint of roof mounted mechanical equipment	International Building Code 2018-1705.11			TBD
Plumbing Inspections	Underground inspection after trenches or ditches are excavated and piping installed, prior to backfill in place.	International Plumbing Code 2018 - 107.2			TBD
	Rough-in inspection prior to wall or ceiling membranes	International Plumbing Code 2018 – 107.2			TBD
	Final inspection after building is complete, all plumbing fixtures are in place and properly connected, and the structure is ready for occupancy	International Plumbing Code 2018-107.2		x	
Electrical Inspections	Underground inspection after trenches or ditches are excavated and conduit installed, prior to backfill in place.	National Electrical Code 2017 – 300.5			TBD
	Rough-in inspection prior to wall or ceiling membranes	National Electrical Code 2017 – Chapter 3			TBD
Plumbing, Mechanical & Electrical Comp	Manufacturer certification required on mechanical & plumbing equipment	Specification 230548		X	
	Inspection of label & anchorage of mechanical & plumbing equipment	International Building Code 2018 – 1705.12.4, 1705.12.6			TBD
	Manufacturer certification required on electrical equipment	Specification 260548		X	
	Inspection of label & anchorage of electrical equipment	International Building Code 2018 - 1705.12.4, 1705.12.6			TBD
	Seismic isolators, review of submittal	Specification 230548 & 260548		X	

MATERIALS	TYPE OF INSPECTION	SPECIFICATION OR CODE REFERENCE	INSPECTION BY		
			ARCH	*ENG*	*Testing Company*
Fire Protec-tion Compo-nents	Seismic Bracing	Specification 210010, 210500, NFPA 13 – 2016 Edition, and NFPA 14 – 2016 Edition			TBD

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

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

1.2 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

    1. For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.

1.3 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

B. Industry Organizations, List: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. Abbreviations and acronyms not included in this list are to mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States." The information in this list is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. AABC - Associated Air Balance Council; www.aabc.com.
2. AAMA - American Architectural Manufacturers Association; (see FGIA).
3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
7. ABMA - American Boiler Manufacturers Association; www.abma.com.
8. ACI - American Concrete Institute; www.concrete.org.
9. ACP - American Clean Power; (Formerly: American Wind Energy Association); www.cleanpower.org.
10. ACPA - American Concrete Pipe Association; www.concretepipe.org.
11. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
12. AF&PA - American Forest & Paper Association; www.afandpa.org.
13. AGA - American Gas Association; www.aga.org.
14. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
15. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
16. AI - Asphalt Institute; www.asphaltinstitute.org.
17. AIA - American Institute of Architects (The); www.aia.org.
18. AISC - American Institute of Steel Construction; www.aisc.org.
19. AISI - American Iron and Steel Institute; www.steel.org.
20. AITC - American Institute of Timber Construction; (see PLIB).
21. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
22. AMPP - Association for Materials Protection and Performance; www.ampp.org.
23. ANSI - American National Standards Institute; www.ansi.org.
24. AOSA/SCST - Association of Official Seed Analysts (The)/Society of Commercial Seed Technologists (The); www.analyzeseeds.com.
25. APA - APA - The Engineered Wood Association; www.apawood.org.
26. APA - Architectural Precast Association; www.archprecast.org.
27. API - American Petroleum Institute; www.api.org.
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASA - Acoustical Society of America; www.acousticalsociety.org.
30. ASCE - American Society of Civil Engineers; www.asce.org.
31. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (see ASCE).

32. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
33. ASME - ASME International; American Society of Mechanical Engineers (The); www.asme.org.
34. ASSE - ASSE International; (American Society of Sanitary Engineering); www.asse-plumbing.org.
35. ASSP - American Society of Safety Professionals; www.assp.org.
36. ASTM - ASTM International; www.astm.org.
37. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
38. AVIXA - Audiovisual and Integrated Experience Association; www.avixa.org.
39. AWI - Architectural Woodwork Institute; www.awinet.org.
40. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
41. AWPA - American Wood Protection Association; www.awpa.com.
42. AWS - American Welding Society; www.aws.org.
43. AWWA - American Water Works Association; www.awwa.org.
44. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
45. BIA - Brick Industry Association (The); www.gobrick.com.
46. BICSI - BICSI, Inc.; www.bicsi.org.
47. BIFMA - Business and Institutional Furniture Manufacturer's Association; www.bifma.org.
48. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
49. BWF - Badminton World Federation; www.bwfbadminton.com.
50. CARB - California Air Resources Board; www.arb.ca.gov.
51. CDA - Copper Development Association Inc.; www.copper.org.
52. CE - Conformite Europeenne (European Commission); www.ec.europa.eu/growth/single-market/ce-marking.
53. CEA - Canadian Electricity Association; www.electricity.ca.
54. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
55. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
56. CGA - Compressed Gas Association; www.cganet.com.
57. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
58. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
59. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
60. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
61. CPA - Composite Panel Association; www.compositepanel.org.
62. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
63. CRRC - Cool Roof Rating Council; www.coolroofs.org.
64. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
65. CSA - CSA Group; www.csagroup.org.
66. CSI - Cast Stone Institute; www.caststone.org.
67. CSI - Construction Specifications Institute (The); www.csiresources.org.
68. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
69. CTA - Consumer Technology Association; www.cta.tech.
70. CTI - Cooling Technology Institute; www.coolingtechnology.org.
71. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
72. DHA - Decorative Hardwoods Association; www.decorativehardwoods.org.
73. DHI - Door and Hardware Institute; www.dhi.org.
74. ECIA - Electronic Components Industry Association; www.ecianow.org.
75. EIMA - EIFS Industry Members Association; www.eima.com.

76. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
77. EOS/ESD - EOS/ESD Association, Inc.; Electrostatic Discharge Association; www.esda.org.
78. ESTA - Entertainment Services and Technology Association; www.esta.org.
79. EVO - Efficiency Valuation Organization; www.evo-world.org.
80. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
81. FGIA - Fenestration and Glazing Industry Alliance; https://fgiaonline.org.
82. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
83. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
84. FM Approvals - FM Approvals LLC; www.fmapprovals.com.
85. FM Global - FM Global; www.fmglobal.com.
86. FRSA - Florida Roofing and Sheet Metal Contractors Association, Inc.; www.floridaroof.com.
87. FSA - Fluid Sealing Association; www.fluidsealing.com.
88. FSC - Forest Stewardship Council U.S.; www.fscus.org.
89. GA - Gypsum Association; www.gypsum.org.
90. GS - Green Seal; www.greenseal.org.
91. HI - Hydraulic Institute; www.pumps.org.
92. HMMA - Hollow Metal Manufacturers Association; (see NAAMM).
93. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
94. IAS - International Accreditation Service; www.iasonline.org.
95. ICC - International Code Council; www.iccsafe.org.
96. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
97. ICPA - International Cast Polymer Association (The); www.theicpa.com.
98. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
99. IEC - International Electrotechnical Commission; www.iec.ch.
100. IEEE SA - IEEE Standards Association; https://standards.ieee.org.
101. IES - Illuminating Engineering Society; www.ies.org.
102. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
103. IGMA - Insulating Glass Manufacturers Alliance; (see FGIA).
104. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.org.
105. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
106. Intertek - Intertek Group; www.intertek.com.
107. ISA - International Society of Automation (The); www.isa.org.
108. ISFA - International Surface Fabricators Association; www.isfanow.org.
109. ISO - International Organization for Standardization; www.iso.org.
110. ITU - International Telecommunication Union; www.itu.int.
111. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
112. LPI - Lightning Protection Institute; www.lightning.org.
113. MBMA - Metal Building Manufacturers Association; www.mbma.com.
114. MCA - Metal Construction Association; www.metalconstruction.org.
115. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
116. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
117. MHI - Material Handling Industry; www.mhi.org.
118. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
119. MPI - Master Painters Institute; www.paintinfo.com.
120. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry, Inc.; www.msshq.org.

121. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
122. NACE - NACE International; (National Association of Corrosion Engineers International); (see AMPP).
123. NADCA - National Air Duct Cleaners Association; www.nadca.com.
124. NAIMA - North American Insulation Manufacturers Association; www.insulationinstitute.org.
125. NALP - National Association of Landscape Professionals; www.landscapeprofessionals.org.
126. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
127. NBI - New Buildings Institute; www.newbuildings.org.
128. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
129. NCMA - National Concrete Masonry Association; www.ncma.org.
130. NEBB - National Environmental Balancing Bureau; www.nebb.org.
131. NECA - National Electrical Contractors Association; www.necanet.org.
132. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
133. NEMA - National Electrical Manufacturers Association; www.nema.org.
134. NETA - InterNational Electrical Testing Association; www.netaworld.org.
135. NFHS - National Federation of State High School Associations; www.nfhs.org.
136. NFPA - National Fire Protection Association; www.nfpa.org.
137. NFPA - NFPA International; (see NFPA).
138. NFRC - National Fenestration Rating Council; www.nfrc.org.
139. NGA - National Glass Association; www.glass.org.
140. NHLA - National Hardwood Lumber Association; www.nhla.com.
141. NLGA - National Lumber Grades Authority; www.nlga.org.
142. NOFMA - National Oak Flooring Manufacturers Association; (see NWFA).
143. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
144. NRCA - National Roofing Contractors Association; www.nrca.net.
145. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
146. NSF - NSF International; www.nsf.org.
147. NSI - Natural Stone Institute; www.naturalstoneinstitute.org.
148. NSPE - National Society of Professional Engineers; www.nspe.org.
149. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
150. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
151. NWFA - National Wood Flooring Association; www.nwfa.org.
152. NWRA - National Waste & Recycling Association; www.wasterecycling.org.
153. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
154. PDI - Plumbing & Drainage Institute; www.pdionline.org.
155. PLASA - PLASA; www.plasa.org.
156. PLIB - Pacific Lumber Inspection Bureau; www.plib.org.
157. PVCPA - Uni-Bell PVC Pipe Association; www.uni-bell.org.
158. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
159. RFCI - Resilient Floor Covering Institute; www.rfci.com.
160. RIS - Redwood Inspection Service; (see WWPA).
161. SAE - SAE International; www.sae.org.
162. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
163. SDI - Steel Deck Institute; www.sdi.org.
164. SDI - Steel Door Institute; www.steeldoor.org.
165. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.

166. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (see ASCE).
167. SIA - Security Industry Association; www.securityindustry.org.
168. SJI - Steel Joist Institute; www.steeljoist.org.
169. SMA - Screen Manufacturers Association; www.smainfo.org.
170. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
171. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
172. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
173. SPIB - Southern Pine Inspection Bureau; www.spib.org.
174. SPRI - Single Ply Roofing Industry; www.spri.org.
175. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
176. SSINA - Specialty Steel Industry of North America; www.ssina.com.
177. SSPC - SSPC: The Society for Protective Coatings; (see AMPP).
178. STI/SPFA - Steel Tank Institute/Steel Plate Fabricators Association; www.steeltank.com.
179. SWI - Steel Window Institute; www.steelwindows.com.
180. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
181. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
182. TCNA - Tile Council of North America, Inc.; www.tcnatile.com.
183. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.kbcdco.tema.org.
184. TIA - Telecommunications Industry Association (The); www.tiaonline.org.
185. TMS - The Masonry Society; www.masonrysociety.org.
186. TPI - Truss Plate Institute; www.tpinst.org.
187. TPI - Turfgrass Producers International; www.turfgrasssod.org.
188. TRI - Tile Roofing Industry Alliance; www.tileroofing.org.
189. ULSE - UL Standards & Engagement Inc.; www.ulse.org.
190. UL - UL Solutions Inc.; www.ul.com.
191. USAV - USA Volleyball; www.usavolleyball.org.
192. USGBC - U.S. Green Building Council; www.usgbc.org.
193. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
194. WA - Wallcoverings Association; www.wallcoverings.org.
195. WCLIB - West Coast Lumber Inspection Bureau; (see PLIB).
196. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
197. WDMA - Window & Door Manufacturers Association; www.wdma.com.
198. WI - Woodwork Institute; www.woodworkinstitute.com.
199. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
200. WWPA - Western Wood Products Association; www.wwpa.org.

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut fur Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. CPSC - U.S. Consumer Product Safety Commission; www.cpsc.gov.
2. DOC - U.S. Department of Commerce; www.commerce.gov.
3. DOD - U.S. Department of Defense; www.defense.gov.
4. DOE - U.S. Department of Energy; www.energy.gov.
5. DOJ - U.S. Department of Justice; www.ojp.usdoj.gov
6. DOS - U.S. Department of State; www.state.gov.
7. EPA - United States Environmental Protection Agency; www.epa.gov.
8. FAA - Federal Aviation Administration; www.faa.gov.
9. GPO - U.S. Government Publishing Office; www.gpo.gov.
10. GSA - U.S. General Services Administration; www.gsa.gov.
11. HUD - U.S. Department of Housing and Urban Development; www.hud.gov.
12. LBNL - Lawrence Berkeley National Laboratory; Energy Technologies Area; www.lbl.gov/.
13. NIST - National Institute of Standards and Technology; www.nist.gov.
14. OSHA - Occupational Safety & Health Administration; www.osha.gov.
15. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
16. USACE - U.S. Army Corps of Engineers; www.usace.army.mil.
17. USDA - U.S. Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
18. USDA - U.S. Department of Agriculture; Rural Utilities Service; www.usda.gov.
19. USP - U.S. Pharmacopeial Convention; www.usp.org.
20. USPS - United States Postal Service; www.usps.com.

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CFR - Code of Federal Regulations; Available from U.S. Government Publishing Office; www.govinfo.gov.
2. DOD - U.S. Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.dsp.dla.mil/Specs-Standards/.
3. DSCC - Defense Supply Center Columbus; (see FS).
4. FED-STD - Federal Standard; (see FS).
5. FS - Federal Specification; Available from DLA Document Services; www.dsp.dla.mil/Specs-Standards/.

    a. Available from Defense Standardization Program; www.dsp.dla.mil.
    b. Available from U.S. General Services Administration; www.gsa.gov.
    c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org.

6. MILSPEC - Military Specifications and Standards; (see DOD).
7. USAB - United States Access Board; www.access-board.gov.

8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (see USAB).

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

1. BEARHFTI; California Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; (see BHGS).
2. BHGS; State of California Bureau of Household Goods and Services; (Formerly: California Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation); www.bhgs.dca.ca.gov.
3. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.oal.ca.gov/publications/ccr/.
4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cdph.ca.gov/Programs/CCDPHP/DEODC/EHLB/IAQ/Pages/Main-Page.aspx.
5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; https://tfsweb.tamu.edu/.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 014339 - MOCKUPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Integrated exterior mockups.

B. Related Requirements:

1. Section 014000 "Quality Requirements" for quality assurance requirements for aesthetic and workmanship mockups specified in other Sections.

1.2 DEFINITIONS

A. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as freestanding temporary built elements, consisting of multiple products, assemblies, and subassemblies.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, testing and inspecting agency representative, and installers of major systems whose Work is included in integrated exterior mockups.
2. Review locations and extent of mockups.

1.4 ACTION SUBMITTALS

A. Shop Drawings: For integrated exterior mockups.

1. Include plans, elevations, sections, and mounting attachment and support details.
2. Indicate manufacturer and model number of individual components, subassemblies, and assemblies.

B. Delegated Design Submittal: For temporary structural supports for mockups not attached to building structure, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 QUALITY ASSURANCE

A. Build mockups to do the following:

1. Verify selections made under Sample submittals.
2. Demonstrate aesthetic effects.
3. Demonstrate the qualities of products and workmanship.
4. Demonstrate acceptable coordination between components and systems.

B. Fabrication: Before fabricating or installing portions of the Work requiring mockups, build mockups for each form of construction and finish required. Use materials and installation methods as required for the Work.

1. Build mockups of size indicated.
2. Build mockups in location indicated or, if not indicated, as directed by Architect.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed unless otherwise indicated.

C. Notifications:

1. Notify Architect seven days in advance of the dates and times when mockups will be constructed.
2. Allow seven days for initial review and each re-review of each mockup.

D. Approval: Obtain Architect's approval of mockups before starting fabrication or construction of corresponding Work.

1. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.6 COORDINATION

A. Coordinate schedule for construction of mockups, so construction, testing, and review of mockups do not impact Project schedule.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design support structure for free-standing mockups.
B. Structural Performance:

1. Seismic Performance: Mockups and support structure to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.
2. Wind Loads: As indicated on Drawings.

2.2 INTEGRATED EXTERIOR MOCKUPS

A. Construct integrated exterior mockups according to approved mockup Shop Drawings and as indicated on Drawings. Construct mockups to demonstrate constructability, coordination of trades, and sequencing of Work; and to ensure materials, components, subassemblies, assemblies, and interfaces integrate into a system complying with indicated performance and aesthetic requirements.

B. Design and construct foundation and superstructure to support free-standing integrated exterior mockups.

C. Build integrated exterior mockups using installers and construction methods that will be used in completed construction.

D. Use specified products that have been approved by Architect. Coordinate installation of materials and products specified in individual Specification Sections that include Work included in integrated exterior mockups.

E. The Work of integrated exterior mockups includes, but is not limited to, the following:

1. Cast stone.
2. Masonry veneer.
3. Cold-formed metal framing and sheathing.
4. Air and weather barriers.
5. Thermal insulation.
6. Through-wall flashing.
7. Flashing and sheet metal trim.
8. Joint sealants.
9. Aluminum-framed entrances and storefront.
10. Aluminum windows.
11. Glazing.

F. Photographic Documentation: Document construction of integrated exterior mockups with photographs in accordance with Section 013233 "Photographic Documentation." Provide photographs showing details of interface of different materials and assemblies.

G. Retain approved mockups constructed in place. Incorporate fully into the Work.

END OF SECTION 014339

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
B. Related Requirements:

1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.2 USE CHARGES

A. Installation, removal, and use charges for temporary facilities to be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.
B. Sewer Service: Pay sewer-service use charges for sewer usage by all entities for construction operations.
C. Water Service: Pay water-service use charges for water used by all entities for construction operations.
D. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.

1.3 INFORMATIONAL SUBMITTALS

A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.
C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
D. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

E. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

F. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.

1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
3. Indicate methods to be used to avoid trapping water in finished work.

G. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:

1. Locations of dust-control partitions at each phase of work.
2. HVAC system isolation schematic drawing.
3. Location of proposed air-filtration system discharge.
4. Waste-handling procedures.
5. Other dust-control measures.

H. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by Owner. Include the following:

1. Methods used to meet the goals and requirements of Owner.
2. Concrete cutting method(s) to be used.
3. Location of construction devices on the site.
4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with Owner.

1.4 QUALITY ASSURANCE

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

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.8-mm-) thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top rails.

B. Portable Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.8-mm-) thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top and bottom rails. Provide concrete / galvanized-steel bases for supporting posts.

C. Fencing Windscreen Privacy Screen: Polyester fabric scrim with grommets for attachment to chain-link fence, sized to height of fence, in color selected by Architect from manufacturer's standard colors.

2.2 TEMPORARY FACILITIES

A. Field Offices:

1. Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.3 EQUIPMENT

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

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille

in system and remove at end of construction and clean HVAC system as required in Section 017700 "Closeout Procedures."

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service:

1. Install water service and distribution piping in sizes and pressures adequate for construction.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

1. Use of Permanent Toilets: Use of Owner's existing or new toilet facilities is not permitted.

E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

F. Electric Power Service:

1. Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

a. Install electric power service overhead unless otherwise indicated.

G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

H. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install WiFi cell phone access equipment.

I. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Architect and Owner.

J. Project Computer: Provide a desktop computer in the primary field office adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications.

1. Internet Service: Broadband modem, router, and ISP, equipped with hardware firewall, providing minimum 10.0 -Mbps upload and 15 -Mbps download speeds at each computer.
2. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.

3.4 SUPPORT FACILITIES INSTALLATION

A. Comply with the following:

1. Provide construction for temporary field offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines that is noncombustible in accordance with ASTM E136. Comply with NFPA 241.
2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas as indicated on Drawings.

1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

C. Temporary Use of Planned Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
2. Prepare subgrade and install subbase and base for temporary roads and paved areas in accordance with Section 312000 "Earth Moving."
3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course in accordance with Section 321216 "Asphalt Paving."

D. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

E. Parking: Use designated area of site (future parking lot / current putting green at corner of Citadel Dr and University Dr) for construction personnel. Area along University Drive adjacent to construction site may be utilized for parking. Maintain access to current clubhouse and golf cart path.

F. Storage and Staging: Use designated areas of Project site for storage and staging needs. (Future parking lot / current putting green at corner of Citadel Dr and University Dr)

G. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

H. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated on Drawings.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

a. Provide temporary, directional signs for construction personnel and visitors.

3. Maintain and touch up signs, so they are legible at all times.

I. Waste Disposal Facilities:

1. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
2. Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."

J. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

K. Temporary Elevator Use: Use of elevators is not permitted.
L. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Section 011000 "Summary."

C. Temporary Erosion and Sedimentation Control:

1. Comply with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent and requirements specified in Section 311000 "Site Clearing."
2. Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, in accordance with erosion- and sedimentation-control Drawings.

a. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.

b. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
c. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
d. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

E. Tree and Plant Protection:
1. Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals, so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.

G. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations and As indicated on Drawings.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.

H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.

I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

J. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.

K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

L. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.

1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.6 MOISTURE AND MOLD CONTROL

A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.

B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard and replace stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.

D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.7 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of This Section Includes: Administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Requirements:

1. Section 011000 "Summary" for Contractor requirements related to Owner-furnished products.
2. Section 012300 "Alternates" for products selected under an alternate.
3. Section 012500 "Substitution Procedures" for requests for substitutions.
4. Section 014200 "References" for applicable industry standards for products specified.
5. Section 017700 "Closeout Procedures" for submitting warranties.

1.2 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products unless otherwise indicated.
3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.

1. Evaluating Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight,

dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.

C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:

1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
2. Data indicating compliance with the requirements specified in "Comparable Products" Article.

E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."

F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

1.3 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is inconspicuous.
2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:

a. Name of product and manufacturer.
b. Model and serial number.
c. Capacity.

d. Speed.
e. Ratings.

3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

1.4 COORDINATION

A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.

C. Storage:

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

1.6 PRODUCT WARRANTIES

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

1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of Owner or endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of Owner or endorsed by manufacturer to Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

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

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

a. Submit additional documentation required by Architect in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by Architect, whose determination is final.

B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

   a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."

2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

   a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."

3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

   a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."

4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.

   a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
   b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.

5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.

   a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."

6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.

a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.

7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.

C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.

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

E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.

1. Select products for which sustainable design documentation submittals are available from manufacturer.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:

1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.

2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for a comparable product. Architect will notify Contractor of approval or rejection of proposed comparable product within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

1. Architect's Approval of Submittal: Marked with approval notation from Architect's action stamp Indication of approval in web-based Project management software. See Section 013300 "Submittal Procedures."
2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

C. Submittal Requirements, Single-Step Process: When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by Architect of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:

1. Construction layout.
2. Field engineering.
3. Installation.
4. Cutting and patching.
5. Coordination of Owner's portion of the Work.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.
9. Correction of the Work.

B. Related Requirements:

1. Section 011000 "Summary" for coordination of Owner-furnished products, Owner-performed work, Owner's separate contracts, and limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
4. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.
5. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.2 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.3 PREINSTALLATION MEETINGS

A. Cutting and Patching Conference: Conduct conference at Project site.

1. Prior to commencing work requiring cutting and patching, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Inform Architect of scheduled meeting. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:

    a. Contractor's superintendent.
    b. Trade supervisor responsible for cutting operations.
    c. Trade supervisor(s) responsible for patching of each type of substrate.
    d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affected by cutting and patching operations.

2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

B. Layout Conference: Conduct conference at Project site.

1. Prior to establishing layout of new perimeter and structural column grid(s), review building location requirements. Review benchmark, control point, and layout and dimension requirements. Inform Architect of scheduled meeting. Require representatives of each entity directly concerned with Project layout to attend, including the following:

    a. Contractor's superintendent.
    b. Professional surveyor Contractor's personnel responsible for performing Project surveying and layout.
    c. Professional surveyor responsible for performing site survey serving as basis for Project design.

2. Review meanings and intent of dimensions, notes, terms, graphic symbols, and other layout information indicated on the Drawings.
3. Review requirements for including layouts on Shop Drawings and other submittals.
4. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor.
B. Certified Surveys: Submit two copies signed by land surveyor.
C. Certificates: Submit certificate signed by land surveyor, certifying that location and elevation of improvements comply with requirements.
D. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:

1. Extent: Describe reason for and extent of each occurrence of cutting and patching.

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

    a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

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

1.5 CLOSEOUT SUBMITTALS

A. Final Property Survey: Submit 4 copies showing the Work performed and record survey data.

1.6 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

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

    a. Primary operational systems and equipment.
    b. Fire separation assemblies.
    c. Air or smoke barriers.
    d. Fire-suppression systems.
    e. Plumbing piping systems.
    f. Mechanical systems piping and ducts.
    g. Control systems.

h. Communication systems.
i. Fire-detection and -alarm systems.
j. Conveying systems.
k. Electrical wiring systems.
l. Operating systems of special construction.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:

a. Water, moisture, or vapor barriers.
b. Membranes and flashings.
c. Exterior curtain-wall construction.
d. Sprayed fire-resistive material.
e. Equipment supports.
f. Piping, ductwork, vessels, and equipment.
g. Noise- and vibration-control elements and systems.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

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

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect promptly.
B. Engage a land surveyor experienced in laying out the Work, using the following accepted surveying practices:

    1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
    2. Establish limits on use of Project site.
    3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
    4. Inform installers of lines and levels to which they must comply.
    5. Check the location, level and plumb, of every major element as the Work progresses.
    6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
    7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.
B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3.5 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb, and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces, unless otherwise indicated on Drawings.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.

F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.

G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.6 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

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

C. Temporary Support: Provide temporary support of Work to be cut.
D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."
F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

    1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
    2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
    3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
    4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
    5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
    6. Proceed with patching after construction operations requiring cutting are complete.

H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.

    1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
    2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

        a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
        b. Restore damaged pipe covering to its original condition.

    3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall

coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 COORDINATION OF OWNER'S PORTION OF THE WORK

A. Site Access: Provide access to Project site for Owner's construction personnel and Owner's separate contractors.

1. Provide temporary facilities required for Owner-furnished, Contractor-installed and Owner-furnished, Owner-installed products.
2. Refer to Section 011000 "Summary" for other requirements for Owner-furnished, Contractor-installed and Owner-furnished, Owner-installed products.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel and Owner's separate contractors.

1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
2. Preinstallation Conferences: Include Owner's construction personnel and Owner's separate contractors at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).

3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, in accordance with regulations.

    a. Use containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces in accordance with written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls." andSection 017419 "Construction Waste Management and Disposal."

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

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

3.9 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.11 CORRECTION OF THE WORK

A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.

    1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.
C. Restore permanent facilities used during construction to their specified condition.
D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition and construction waste.
2. Recycling nonhazardous demolition and construction waste.
3. Disposing of nonhazardous demolition and construction waste.

1.3 DEFINITIONS

A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.
C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.
D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 MATERIALS OWNERSHIP

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

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 30 days of date established for commencement of the Work. Include a preconstruction waste management plan per 5.6.1.1.
B. Complete a final waste management summary report after construction documenting the results of the implementation of the preconstruction waste management plan.
C. Document amount of construction waste, per unit area of new building floor area, generated in new portions of the buildings – must be kept below 1.2lb/sf
D. Document percentage of construction waste including building demolition waste and packaging that is diverted from the landfill through recycling, reuse, repurposing, or composting (minimum 75%).

1.6 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Include the following information:

1. Material category.
2. Generation point of waste.
3. Total quantity of waste in tons (tonnes).
4. Quantity of waste salvaged, both estimated and actual in tons (tonnes).
5. Quantity of waste recycled, both estimated and actual in tons (tonnes).
6. Total quantity of waste recovered (salvaged plus recycled) in tons (tonnes).
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

G. Sustainable Design Submittal: Submit documentation to GBI-authorized Assessor signed by Contractor, tabulating total waste material, quantities diverted and means by which it is diverted, and statement that requirements for the credit have been met. Respond to questions and requests from GBI-authorized Assessor until GBI-authorized Assessor has made its determination on Project's Green Globes certification application. Document correspondence with GBI-authorized Assessor as informational submittals.

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

I. Refrigerant Recovery: Comply with requirements in Section 024119 "Selective Demolition" for refrigerant recovery submittals.

1.7 QUALITY ASSURANCE

A. Waste Management Coordinator Qualifications: Experienced firm, or individual employed and assigned by General Contractor, with a record of successful waste management coordination of projects with similar requirements. Superintendent may not serve as Waste Management Coordinator.

B. Refrigerant Recovery Technician Qualifications: Universal certified by EPA-approved certification program.

C. Refrigerant Recovery Technician Qualifications: Comply with requirements in Section 024119 "Selective Demolition."

D. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.

E. Waste Management Conference(s): Conduct conference(s) at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan including responsibilities of each contractor and waste management coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

1.8 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
   1. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
   2. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
   3. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
   4. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

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

   1. Total quantity of waste.
   2. Estimated cost of disposal (cost per unit). Include transportation and tipping fees and cost of collection containers and handling for each type of waste.
   3. Total cost of disposal (with no waste management).
   4. Revenue from salvaged materials.
   5. Revenue from recycled materials.
   6. Savings in transportation and tipping fees by donating materials.
   7. Savings in transportation and tipping fees that are avoided.
   8. Handling and transportation costs. Include cost of collection containers for each type of waste.
   9. Net additional cost or net savings from waste management plan.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Achieve end-of-Project rates for salvage/recycling of 75 percent by weight of total nonhazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and

demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:

1. Demolition Waste:

    a. Asphalt paving.
    b. Concrete.
    c. Concrete reinforcing steel.
    d. Brick.
    e. Concrete masonry units.
    f. Wood studs.
    g. Wood joists.
    h. Plywood and oriented strand board.
    i. Wood paneling.
    j. Wood trim.
    k. Structural and miscellaneous steel.
    l. Rough hardware.
    m. Roofing.
    n. Insulation.
    o. Doors and frames.
    p. Door hardware.
    q. Windows.
    r. Glazing.
    s. Metal studs.
    t. Gypsum board.
    u. Acoustical tile and panels.
    v. Carpet.
    w. Carpet pad.
    x. Demountable partitions.
    y. Equipment.
    z. Cabinets.
    aa. Plumbing fixtures.
    bb. Piping.
    cc. Supports and hangers.
    dd. Valves.
    ee. Sprinklers.
    ff. Mechanical equipment.
    gg. Refrigerants.
    hh. Electrical conduit.
    ii. Copper wiring.
    jj. Lighting fixtures.
    kk. Lamps.
    ll. Ballasts.
    mm. Electrical devices.
    nn. Switchgear and panelboards.
    oo. Transformers.

2. Construction Waste:

    a. Masonry and CMU.

b. Lumber.
c. Wood sheet materials.
d. Wood trim.
e. Metals.
f. Roofing.
g. Insulation.
h. Carpet and pad.
i. Gypsum board.
j. Piping.
k. Electrical conduit.
l. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:

1) Paper.
2) Cardboard.
3) Boxes.
4) Plastic sheet and film.
5) Polystyrene packaging.
6) Wood crates.
7) Wood pallets.
8) Plastic pails.

m. Construction Office Waste: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following construction office waste materials:

1) Paper.
2) Aluminum cans.
3) Glass containers.

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."

B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.
C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

1. Distribute waste management plan to everyone concerned within three days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

A. Comply with requirements in Section 024119 "Selective Demolition" for salvaging demolition waste.
B. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until installation.
4. Protect items from damage during transport and storage.
5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

C. Salvaged Items for Sale and Donation: Not permitted on Project site.
D. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

E. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.
F. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.
G. Plumbing Fixtures: Separate by type and size.

H. Lighting Fixtures: Separate lamps by type and protect from breakage.
I. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.
B. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

    a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

3.4 RECYCLING DEMOLITION WASTE

A. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.
B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
C. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
D. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
E. Metals: Separate metals by type.

1. Structural Steel: Stack members according to size, type of member, and length.
2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

F. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.
G. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
H. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
I. Metal Suspension System: Separate metal members, including trim and other metals from acoustical panels and tile, and sort with other metals.
J. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.

1. Store clean, dry carpet and pad in a closed container or trailer provided by carpet reclamation agency or carpet recycler.

K. Carpet Tile: Remove debris, trash, and adhesive.

1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by carpet reclamation agency or carpet recycler.

L. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, sprinklers, and other components by material and size.
M. Conduit: Reduce conduit to straight lengths and store by material and size.
N. Lamps: Separate lamps by type and store according to requirements in 40 CFR 273.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

D. Paint: Seal containers and store by type.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. General: Except for items or materials to be salvaged or recycled, remove waste materials and legally dispose of at designated spoil areas on Owner's property.

C. Burning: Do not burn waste materials.

END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final Completion procedures.
3. List of incomplete items.
4. Submittal of Project warranties.
5. Final cleaning.

B. Related Requirements:

1. Section 012900 "Payment Procedures" for requirements for Applications for Payment for Substantial Completion and Final Completion.
2. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
3. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
4. Section 017900 "Demonstration and Training" for requirements to train Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.2 DEFINITIONS

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

1.3 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.
B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.
C. Field Report: For pest-control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.
B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.

    a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner's signature for receipt of submittals.

5. Submit testing, adjusting, and balancing records.
6. Submit sustainable design submittals not previously submitted.
7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.

2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Advise Owner of changeover in utility services.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements.
10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:

1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list will state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.
5. Submit Final Completion photographic documentation.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection

or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor, listed by room or space number.
2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

    a. Project name.
    b. Date.
    c. Name of Architect.
    d. Name of Contractor.
    e. Page number.

4. Submit list of incomplete items in the following format:
    a. PDF Electronic File: Architect will return annotated file.
    b. Web-Based Project Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list).

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

1. Submit by email to Architect.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

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

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Clean flooring, removing debris, dirt, and staining; clean in accordance with manufacturer's instructions.
i. Vacuum and mop concrete.
j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean in accordance with manufacturer's instructions if visible soil or stains remain.

k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
l. Remove labels that are not permanent.
m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
p. Clean ducts, blowers, and coils.
q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
r. Clean strainers.
s. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.
D. Construction Waste Disposal: Comply with waste-disposal requirements in Section 015000 "Temporary Facilities and Controls." And Section 017419 "Construction Waste Management and Disposal."

3.2 CORRECTION OF THE WORK

A. Complete repair and restoration operations required by "Correction of the Work" Article in Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory manuals.
2. Emergency manuals.
3. Systems and equipment operation manuals.
4. Systems and equipment maintenance manuals.
5. Product maintenance manuals.

B. Related Requirements:
1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Section 019113 "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.

1.3 DEFINITIONS

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

1.4 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect and Commissioning Authority will comment on whether content of operation and maintenance submittals is acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operation and maintenance manuals in the following format:

1. Submit on digital media acceptable to Architect or by email to Architect. Enable reviewer comments on draft submittals.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Authority will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.

1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.

E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Architect.
7. Name and contact information for Commissioning Authority.
8. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
9. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

D. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:

1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.8 EMERGENCY MANUALS

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

E. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

1.9 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.10 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent,

and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

    a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of maintenance manuals.

1.11 PRODUCT MAINTENANCE MANUALS

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
D. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

E. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record Product Data.
3. Miscellaneous record submittals.

B. Related Requirements:
1. Section 017300 "Execution" for final property survey.
2. Section 017700 "Closeout Procedures" for general closeout procedures.
3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set(s) of marked-up record prints.
2. Number of Copies: Submit copies of Record Drawings as follows:

a. Initial Submittal:

1) Submit one paper-copy set(s) of marked-up record prints.
2) Submit PDF electronic files of scanned record prints and one set(s) of file prints.
3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

b. Final Submittal:
1) Submit PDF electronic files of scanned Record Prints and one set(s) of file prints.
2) Print each drawing, whether or not changes and additional information were recorded.

B. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

C. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

D. Reports: Submit written report weekly indicating items incorporated into Project Record Documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.4 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

    a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    b. Accurately record information in an acceptable drawing technique.
    c. Record data as soon as possible after obtaining it.
    d. Record and check the markup before enclosing concealed installations.
    e. Cross-reference record prints to corresponding photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

    a. Dimensional changes to Drawings.
    b. Revisions to details shown on Drawings.
    c. Depths of foundations.
    d. Locations and depths of underground utilities.
    e. Revisions to routing of piping and conduits.
    f. Revisions to electrical circuitry.
    g. Actual equipment locations.
    h. Duct size and routing.
    i. Locations of concealed internal utilities.
    j. Changes made by Change Order or Construction Change Directive.
    k. Changes made following Architect's written orders.
    l. Details not on the original Contract Drawings.
    m. Field records for variable and concealed conditions.
    n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.

4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order

B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:

    a. Project name.
    b. Date.
    c. Designation "PROJECT RECORD DRAWINGS."
    d. Name of Architect.
    e. Name of Contractor.

1.5 RECORD PRODUCT DATA

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.
B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

C. Format: Submit Record Product Data as annotated PDF electronic file.

1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.6 MISCELLANEOUS RECORD SUBMITTALS

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

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.7 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Instruction in operation and maintenance of systems, subsystems, and equipment.
2. Demonstration and training video recordings.

1.2 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
B. Qualification Data: For facilitator.
C. Attendance Record: For each training module, submit list of participants and length of instruction time.
D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.3 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

1.4 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.5 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

    a. System, subsystem, and equipment descriptions.
    b. Performance and design criteria if Contractor is delegated design responsibility.
    c. Operating standards.
    d. Regulatory requirements.
    e. Equipment function.
    f. Operating characteristics.
    g. Limiting conditions.
    h. Performance curves.

2. Documentation: Review the following items in detail:

    a. Emergency manuals.
    b. Systems and equipment operation manuals.
    c. Systems and equipment maintenance manuals.
    d. Product maintenance manuals.
    e. Project Record Documents.
    f. Identification systems.
    g. Warranties and bonds.
    h. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

    a. Instructions on meaning of warnings, trouble indications, and error messages.
    b. Instructions on stopping.
    c. Shutdown instructions for each type of emergency.
    d. Operating instructions for conditions outside of normal operating limits.
    e. Sequences for electric or electronic systems.
    f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

    a. Startup procedures.

b. Equipment or system break-in procedures.
c. Routine and normal operating instructions.
d. Regulation and control procedures.
e. Control sequences.
f. Safety procedures.
g. Instructions on stopping.
h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:

a. Alignments.
b. Checking adjustments.
c. Noise and vibration adjustments.
d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

a. Diagnostic instructions.
b. Test and inspection procedures.

7. Maintenance: Include the following:

a. Inspection procedures.
b. Types of cleaning agents to be used and methods of cleaning.
c. List of cleaning agents and methods of cleaning detrimental to product.
d. Procedures for routine cleaning.
e. Procedures for preventive maintenance.
f. Procedures for routine maintenance.
g. Instruction on use of special tools.

8. Repairs: Include the following:

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

1.6 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."

B. Set up instructional equipment at instruction location.

1.7 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
2. Owner will furnish an instructor to describe Owner's operational philosophy.
3. Owner will furnish Contractor with names and positions of participants.

C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner, through Architect, with at least seven days' advance notice.

D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
E. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 017900

SECTION 018113.54 - SUSTAINABLE DESIGN REQUIREMENTS - GREEN GLOBES 2021

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: General requirements and procedures for compliance with and certification from the GBI's "Green Globes for New Construction 2021," (hereafter, "Green Globes").

1. Some Green Globes requirements depend on product selections and may not be specifically identified as Green Globes requirements. Compliance with Green Globes requirements may be used as one criterion to evaluate substitution requests and comparable product requests.
2. A copy of Green Globes Project checklist is available to the awarded contractor.

    a. Some Green Globes requirements depend on Architect's design and other aspects of Project that are not part of the Work of the Contract.

1.2 DEFINITIONS

A. Environmental Product Declaration (EPD): A transparency reporting tool communicating what a product is made of and the environmental impact.
B. REL: Recommended exposure limit.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site. Review Green Globes requirements and action plans for compliance with requirements.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Respond to questions and requests from Architect about Green Globes requirements that are Contractor's responsibility, that depend on product selection or product qualities, or that depend on Contractor's procedures.
B. Environmental Management System: Document the following:

1. General Contractor's environmental policy.
2. Regulatory compliance and training.
3. Environmental risk assessment that shows sensitive environmental areas and ranks potential risks that may arise from the construction.
4. Environmental risk management strategies.
5. Environmental management roles, responsibilities, and reporting structure for the construction phase.

6. Site and work instructions for site personnel outlining environmental procedures during construction.
7. Provide a no-smoking policy.
8. Environmental inspection checklists.
9. Records of compliance.

1.5 ACTION SUBMITTALS

A. General: Submit additional sustainable design submittals required by other Sections.
B. Sustainable design submittals are in addition to other submittals.

1. If submitted item is identical to that submitted to comply with other requirements, include an additional copy with other submittal as a record copy of compliance with indicated Green Globes requirements instead of separate sustainable design submittal. Mark additional copy "Sustainable design submittal."

C. Sustainable Design Documentation Submittals:

1. Environmental management system documents.
2. EPDs.
3. Third-party certifications based on multiple attribute standards.
4. Third-party-certified life-cycle product assessments.
5. Documentation complying with Section 017419 "Construction Waste Management and Disposal."
6. Product Data and laboratory test reports for adhesives and sealants indicating VOC content and compliance with requirements for low-emitting materials.
7. Certificates for carpet and undercarpet adhesives indicating compliance with CRI's Green Label Plus testing program.
8. Product Data and laboratory test reports for paints indicating VOC content and compliance with requirements for low-emitting materials.
9. Laboratory test reports for flooring, insulation, acoustical ceilings, and wall coverings, indicating compliance with requirements for low-emitting materials.
10. Indoor-Air-Quality (IAQ) testing report from testing and inspecting agency indicating results of IAQ testing and documentation that show compliance with IAQ testing procedures and requirements.
11. Sustainable submittals are required for all products whether specifically noted in each specification or not.

1.6 INFORMATIONAL SUBMITTALS

A. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude labor, overhead, and profit. Include breakout of costs for the following categories of items:

1. Plumbing.
2. Mechanical.
3. Electrical.

4. Specialty items such as elevators and equipment.
5. Wood-based construction materials.

B. Sustainable Design Action Plans: Provide preliminary submittals within 30 days of date established for commencement of the Work, indicating how the following requirements will be met:

1. List of proposed products with EPDs.
2. List of proposed products complying with requirements for multiple attribute standards.
3. List of proposed products complying with requirements for life-cycle product assessments.
4. General Contractor's environmental policy.
5. Waste management plan complying with Section 017419 "Construction Waste Management and Disposal."
6. Construction IAQ management plan.

C. Sustainable Design Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with sustainable design action plans.

D. Qualification Statements: For Green Globes coordinator.

1.7 QUALITY ASSURANCE

A. Green Globes Coordinator: Engage an experienced coordinator to coordinate Green Globes requirements. Green Globes coordinator may also serve as waste management coordinator.

1. Green Globes coordinator to have previously coordinated at least one Green Globes project(s).

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide products and procedures necessary to comply with Green Globes requirements referenced in this Section. Although other Sections may specify some requirements that contribute to referenced Green Globes requirements, Contractor will determine additional materials and procedures necessary to comply with Green Globes requirements indicated.

2.2 LOW-EMITTING MATERIALS

A. Adhesives and Sealants:

1. For field applications inside the building, adhesives and sealants to comply with the following VOC content limits:

a. Wood Glues: 30 g/L.
b. Metal-to-Metal Adhesives: 30 g/L.
c. Adhesives for Porous Materials (except Wood): 50 g/L.
d. Subfloor Adhesives: 50 g/L.
e. Plastic Foam Adhesives: 50 g/L.
f. Carpet Adhesives: 50 g/L.
g. Carpet Pad Adhesives: 50 g/L.
h. VCT and Asphalt Tile Adhesives: 50 g/L.
i. Cove Base Adhesives: 50 g/L.
j. Gypsum Board and Panel Adhesives: 50 g/L.
k. Rubber Floor Adhesives: 60 g/L.
l. Ceramic Tile Adhesives: 65 g/L.
m. Multipurpose Construction Adhesives: 70 g/L.
n. Fiberglass Adhesives: 80 g/L.
o. Contact Adhesive: 80 g/L.
p. Structural Glazing Adhesives: 100 g/L.
q. Wood Flooring Adhesive: 100 g/L.
r. Single-Ply Roof Membrane Adhesive: 250 g/L.
s. Special-Purpose Contact Adhesive (Contact Adhesive That Is Used to Bond Melamine Covered Board, Metal, Unsupported Vinyl, Rubber, or Wood Veneer 1/16 Inch or Less in Thickness to Any Surface): 250 g/L.
t. Plastic Cement Welding Compounds: 250 g/L.
u. ABS Welding Compounds: 325 g/L.
v. CPVC Welding Compounds: 490 g/L.
w. PVC Welding Compounds: 510 g/L.
x. Adhesive Primer for Plastic: 550 g/L.
y. Architectural Sealants: 250 g/L.
z. Nonmembrane Roof Sealants: 300 g/L.
aa. Single-Ply Roof Membrane Sealants: 450 g/L.
bb. Other Sealants: 420 g/L.

2. For field applications inside the building, adhesives and sealants may contain no more than half of the chronic REL of VOCs when tested in accordance with the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde may not exceed half of the indoor REL or 16.5 mcg/cu. m and that of acetaldehyde may not exceed 9 mcg/cu. m.

B. Flooring
1. Carpet and undercarpet adhesives to comply with CRI's Green Label Plus testing program.
2. Floor Score
3. Greenguard Gold
4. Indoor Advantage Gold

C. Paints:

1. For field applications inside the building, wall paints to comply with the following VOC content limits:

a. Latex Flat Paints: 50 g/L.
b. Latex Nonflat Paints: 150 g/L.

2. For field applications inside the building, wall paints may contain no more than half of the chronic REL of VOCs when tested in accordance with the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde may not exceed half of the indoor REL or 33 mcg/cu. m and that of acetaldehyde may not exceed 9 mcg/cu. m.

D. Flooring and Other Interior Products: Flooring, floor coverings, insulation, acoustical ceilings, and wall coverings may contain no more than half of the chronic REL of VOCs when tested in accordance with the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde may not exceed half of the indoor REL or 33 mcg/cu. m and that of acetaldehyde may not exceed 9 mcg/cu. m.

E. Occupant Exposure Screening Report (OESR) prepared in accordance with ASTM E3182-20 Standard Practice for Preparing an Occupant Exposure Screening Report (OESR) for substances in Installed Building Products. **Manufacturer documentation showing greater than 10 products meeting this requirement.**

2.3 Product Life Cycle

A. Product Life Cycle documentation, Crate to Gate product life cycle certifications. **Manufacturer documentation showing greater than 40 products meeting this requirement.**
B. Product Life Cycle documentation, Crate to Grave product life cycle certifications. **Manufacturer documentation showing greater than 10 products meeting this requirement.**

2.4 Sustainable Materials Attributes

A. Greater than 38% Sustainable Materials Index must be achieved. Sustainable Materials Index (%)=100x($Pre-consumer recycled content+$Post-consumer recycled content+$biobased content+$third-party sustainable forestry certification content+$Eco-Certified Composite)/Total Material Value.

PART 3 - EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT

A. Comply with Section 017419 "Construction Waste Management and Disposal."

3.2 INDOOR-AIR-QUALITY (IAQ) ASSESSMENT

A. Air-Quality Testing: Engage a qualified testing agency to perform the following:

1. Conduct baseline IAQ testing, after construction ends and prior to occupancy, in accordance with the EPA's "Testing for Indoor Air Quality - Section 01 81 09."
2. Indoor air to comply with standards and limits in the EPA's "Testing for Indoor Air Quality - Section 01 81 09."
3. For each sampling point where the maximum concentration limits are exceeded, take corrective action until requirements have been met.
4. For each sampling point where the airborne mold and mildew indoor species distribution varies by more than 10 percent from exterior sampling specification, identify the source of mold and/or mildew and remediate with corrective action, then retest until compliant results are attained.
5. If any noncompliant test results occur, provide a written report describing the source(s) of the noncompliant condition(s) and the corrective action(s) implemented.

3.3 CLOSEOUT ACTIVITIES

A. Site Visit: Arrange for a site visit from Green Globes Assessor to verify compliance with requirements. Cooperate with Green Globes Assessor and provide reasonable auxiliary services as requested. Notify Green Globes Assessor sufficiently in advance of operations to permit assignment of personnel. Provide access to the Work and incidental labor and facilities necessary to facilitate inspections.

END OF SECTION 018113.54

SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. A draft Commissioning Plan documentation is included by reference for information only.

1.2 SUMMARY

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

B. Related Sections:

Section 013546 "Indoor Air Quality Testing " for requirements related to commissioning process activities for testing indoor air quality.

Section 018113 "Sustainable Design Requirements" for Green Globes reporting requirements related to commissioning.

Section 220800 "Commissioning of Service Water Heating Systems" for commissioning process activities for Service Water Heating Systems, assemblies, equipment, and components.

Section 230800 "Commissioning of HVAC" for commissioning process activities for HVAC&R systems, assemblies, equipment, and components.

Section 260800 "Commissioning of Lighting Control Systems" for commissioning process activities for Lighting Control Systems, assemblies, equipment, and components.

1.3 DEFINITIONS

A. BoD: Basis of Design. A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

B. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

C. CxA: Commissioning Authority.

D. OPR: Owner's Project Requirements. A document that details the functional requirements of

a project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

E. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

F. Resolution Tracking Form (RTF or Issues Log): A document that lists all issues identified during the commissioning process including, but not limited to, issue number, date identified, description of the issue, party who identified the issue, party assigned to resolve the issue, issue resolution and verification that issue has been resolved and the date the issue was resolved.

1.4 COMMISSIONING TEAM

A. Members Appointed by Contractor(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.

B. Members Appointed by Owner:
1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner has engaged the CxA under a separate contract with the Architect.
2. Representatives of the facility user and operation and maintenance personnel.
3. Architect and engineering design professionals.

1.5 OWNER'S RESPONSIBILITIES

A. Provide the OPR documentation to the CxA and Contractor for information and use.

B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.

C. Provide the BoD documentation, prepared by Architect and approved by Owner, to the CxA and Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

1.6 CONTRACTOR'S RESPONSIBILITIES

A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
1. Evaluate performance deficiencies identified in test reports and, in collaboration with the entity(ies) responsible for system and equipment installation, recommend corrective action.

2. Cooperate with the CxA for resolution of issues recorded in the Resolution Tracking Form (Issues Log).
3. Attend commissioning team meetings held on a variable basis.
4. Integrate and coordinate commissioning process activities with construction schedule.
5. Complete construction checklists (Pre-Functional Test Checklists, manufacturer and contractor startup sheets and checklists, test reports, TAB reports, etc.) as Work is completed and provide to the Commissioning Authority on a weekly basis or other schedule as mutually agreed to at the Pre-commissioning meeting.
6. Review and accept commissioning process test procedures (Functional Performance Tests) provided by the CxA.
7. Prepare and submit the Certificate of Readiness to the CxA prior to Functional Performance Testing.
8. Complete commissioning Functional Performance Testing procedures.
9. Provide documentation (agendas, sign-in sheets, minutes and related information) of all required training for systems that are being commissioned to the CxA and invite the CxA to all training sessions.

1.7 CxA'S RESPONSIBILITIES

A. Organize and lead the commissioning team.

B. Provide draft initial commissioning plan and update throughout project.

C. Convene commissioning team meetings.

D. Provide Project-specific construction checklists and commissioning process test procedures to the Contractor for completion and incorporation into the Work of the Project.

E. Verify the completion of commissioning process activities using random sampling. The sampling rate may vary from 1 to 100 percent. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the OPR. When a random sample does not meet the requirement, the CxA will report the failure in the Resolution Tracking Form (Issues Log).

F. Prepare and maintain the Resolution Tracking Form (Issues Log).

G. Witness systems, assemblies, equipment, and component startup using random sampling.

H. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning process report.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF SYSTEMS TO BE COMMISSIONED

A. HVAC&R Systems
1. Building Heating and Cooling Systems
2. Pumps
3. Dedicated Outdoor Air Units
4. Air Handling Units
5. Exhaust Fans
6. Electric Unit Heaters
7. Variable Frequency Drives
8. Terminal Units / VAV Devices
9. Duct, Air Distribution Devices, Grilles, Registers and Diffusers
10. Piping
11. Air Filtration Systems
12. Instrumentation and Controls
13. Building Automation System

B. Service Water Heating Systems
1. Water Heaters
2. Hot water recirculation pump
3. Piping
4. Fixtures
5. Instrumentation and Controls
6. Integration with Building Automation System

C. Lighting Control Systems
1. Lighting Control Panels
2. Daylight Harvesting
3. Sensors
4. Switches
5. Wiring
6. Safeties
7. Fixtures
8. Interlocks with smoke control, fire alarm and emergency power systems
9. Integration with Building Automation System

3.2 BUILDING ENVELOPE COMMISSIONING

A. Building Envelope scope of work is limited to the following:
1. Verification that construction activities related to Pre-Installation Meetings, Mockups, Contractor Examinations, Surface Preparations, and Field Quality Control / Assurance and Testing occurs for all systems affecting the building envelope as listed in the contract documents.

a. The CxA is not responsible for completing the construction activities listed above. Completion of these activities are the responsibility of the Contractor, Architect, and Owner as outlined in the project specifications.
b. All activities associated with life safety and fire protection are excluded from this scope.

2. Attend Pre-Installation Meetings associated with the building envelope.
   a. All activities associated with life safety and fire protection are excluded from this scope.
3. Review building envelope related Mockups and provide written comments to the Architect for consideration. Document Architect approvals of Mockups.

4. Compile documentation (i.e. meeting minutes, field reports, and testing results) provided by Contractor for activities described in 3.2.A and include these in the project Systems Manual.

CONTRACTOR'S CERTIFICATE OF READINESS
FOR COMMISSIONING FUNCTIONAL PERFORMANCE TESTING

It is the responsibility of the Contractor to verify the following pre-requisite items are complete in preparation for the Commissioning Authority (CxA) to perform Functional Testing. Every item on this list must be initialed and a signed copy must be received by the CxA prior to arriving on the job site. Please read thoroughly, initial next to the item below and sign as requested.

System(s) to be Commissioned: HVAC, Domestic Hot Water & Lighting Controls
Initial each item below:

_____I verify that the system(s) to be commissioned, including all ductwork, piping, electrical, plumbing, and interfaces to other systems is complete and installed. Issues previously identified by the CxA that could prevent Functional Testing have been resolved.

_____I verify that all manufacturers' field services, factory representative tests and inspections, and factory authorized startup services have been completed as specified and that reports documenting the results of these services have been provided to the CxA.

_____I verify that for HVAC and Plumbing systems, all duct pressure testing, duct cleaning, pipe pressure testing, and pipe flushing has been completed in accordance with the Contract Documents

_____I verify that for HVAC and Domestic Hot Water systems, all Test and Balance work is complete and all issues that could impact Functional Performance Testing have been corrected and that the CxA has been provided with a TAB report.

_____I verify that the systems being testing are online and communicating with the BAS system.

_____I verify that the BAS contractor has completed the calibration of sensors and has completed point to point checks of all sensors and devices.

_____I verify that the BAS contractor has completed checks of all devices (dampers, control valves, etc.) for proper operation, fail position, and verification of no leakage.

_____I verify that they BAS contractor has completed a check of graphics and/or can provide the necessary reports exported from the BAS to confirm testing results.

_____I verify that the BAS contractor has programmed the system for all sequences of operation, set points, alarms, and occupancy schedules.

_____I verify that the BAS system is interfaced with all other systems that require Functional Performance Testing.

_____I verify that I have reviewed the scheduled list of activities on the days that Functional Performance Testing is to take place and made the necessary notifications and coordination to ensure there are no restrictions to testing.

Print Name, Title & Company _____
I understand that if the system(s) listed are not properly prepared for Functional Performance Testing as verified above, necessitating one or more return visits, the Contractor may be charged for additional services.
Signature_____ **Date**_____

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.
4. Abatement Requirements
    a. Asbestos Abatement Specific Requirements
    b. Asbestos Hazard Abatement Plan and Air Monitoring Plan

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 017300 "Execution" for cutting and patching procedures.
3. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.

1.2 DEFINITIONS

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

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and store.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.3 MATERIALS OWNERSHIP

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

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Engineering Survey: Submit engineering survey of condition of building.

C. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

D. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's and other tenants' on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

E. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before Work begins.

F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that

recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

G. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.6 CLOSEOUT SUBMITTALS

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

1.7 QUALITY ASSURANCE

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

1.8 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

1. Before selective demolition, Owner will remove the following items:

a. Any equipment, furniture and materials that Owner desires to move or salvage.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: Present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
1. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
2. Owner will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.9 COORDINATION

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

C. Sustainable Design Requirements for Building Reuse:

1. Maintain the existing building facade where indicated to remain. Do not demolish such existing construction beyond indicated limits.
2. Maintain the existing building structural systems where indicated to remain. Do not demolish such existing construction beyond indicated limits.
3. Maintain the existing interior ceilings, interior partitions, and/or demountable walls where indicated to remain. Do not demolish such existing construction beyond indicated limits.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

E. Survey of Existing Conditions: Record existing conditions by use of measured drawings preconstruction photographs or video.

3.2 PREPARATION

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

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.

2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

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

3.5 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain fire watch during and for at least 24 hours after flame-cutting operations.
6. Maintain adequate ventilation when using cutting torches.
7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
10. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Salvaged Items:

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

D. Removed and Reinstalled Items:

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

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

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

B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction. and recycle or dispose of them according to Section 017419 "Construction Waste Management and Disposal."

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

3.8 CLEANING

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

END OF SECTION 024119

Phoenix EnviroCorp

ASBESTOS ABATEMENT SPECIFIC REQUIREMENTS

Date Issued: July 24, 2023

LOCATION
The work as indicated herein and on the accompanying specifications (The Asbestos Hazard Abatement Plan dated July 24, 2023) shall be performed at the following location:

Hackler Clubhouse
107 Citadel Drive
Conway, SC 29526

SCOPE OF WORK ***(Note: Also see section 2.2 of the above referenced Asbestos Hazard Abatement Plan)***
The work to be accomplished under these specifications consists of furnishing all labor, material, equipment, licenses and permits necessary to remove and discard approximately 1,520 square feet (SF) of asbestos containing tar associated with the shingle roof system, and assumed over 3,000 SF of asbestos containing white/off-white surface material associated with plaster walls/ceilings located in various areas throughout the building.

It is the abatement contractors' responsibility to verify quantities of all materials to be removed.

Specific Requirements

1. All work shall be performed in accordance with all federal, state, and local rules and regulations, and specifications provided in the above referenced Asbestos Hazard Abatement Plan. In the event of a conflict between regulations and specifications, the most stringent of the two shall prevail.

2. The abatement contractor shall ensure that all personnel, including subcontractors, remain in designated areas and restrained from using the owner's property (i.e., brooms, mops, ladders, etc.) to avoid cross contamination of the owner's property.

3. The abatement contractor's equipment and materials must be secured prior to the contractor leaving the site at the end of each shift to avoid contact with other personnel.

4. An Asbestos Waste Disposal Chain of Custody shall be provided for the owner's records. When completing the Waste Disposal Chain of Custody, please refer to the following: (a.) Generator/Owner name and address – Coastal Carolina University, 102 Shop Road, Conway, SC 29526; (b.) Generator/Owner phone number – 843-349-2577; and (c.) Generator/Owner Representative – Rein Mungo; The specific location of where the asbestos containing material was removed as well as approximate amounts shall be listed on the chain of custody.

ASBESTOS HAZARD ABATEMENT PLAN

AND

AIR MONITORING PLAN

FOR

CEILING TEXTURE, DRYWALL/JOINT COMPOUND, VINYL FLOORING

COASTAL CAROLINA UNIVERSITY/HACKLER CLUBHOUSE
107 CITADEL DRIVE
CONWAY, SOUTH CAROLINA 29526

PREPARED BY

Phoenix EnviroCorp

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PART 1: GENERAL

1.1 DESCRIPTION OF WORK

Asbestos Containing Materials:

1. Remove all asbestos containing material as described in the accompanying Asbestos Abatement Specific Requirements dated July 24, 2023.

Engineering Controls:

- Negative Pressure Enclosure (NPE)for all indoor work (i.e., surface material associated with plaster) and a regulated area for all outdoor work (i.e., tar associated with the shingle roof).

Work Practices:

- Remove as described herein in section 2.2

Decontamination Area:

- Full personnel and waste load out decontamination unit for all indoor work (i.e., surface material associated with plaster) and a remote personnel decon unit for all outdoors work (i.e., tar associated with the shingle roof).

Air Monitoring:

- PCM area and personnel sampling and TEM clearance sampling

The work includes the handling of asbestos containing materials (ACM), which shall be encountered during the abatement activities, and the incidental procedures and equipment required to protect workers and occupants in the area from contact with airborne asbestos fibers.

The procedures covered by this Asbestos Hazard Abatement Plan (AHAP) include the demolition, removal, and disposal of Class 1 ACM. The work involves the handling of friable or potentially friable ACM/PACM, and it shall be handled so that it does not present a source of asbestos fiber exposure to the removal contractor's employees, occupants, or maintenance personnel. In addition, area personnel,

materials, and facilities shall be appropriately protected from contamination during removal and disposal.

1.2 REFERENCES

The publications listed below form a part of this AHAP to the extent they are referenced. The publications are referred to in the text by the basis designation only.

1.2.1 Code of Federal Regulations (CFR)

29 CFR 1910.134	1998 Respiratory Protection
29 CFR 1910.145	Specifications for Accident Prevention, Signs and Tags
29 CFR 1910.1200	1988 Hazards Communication
29 CFR 1926.1101	Asbestos Construction Standard
40 CFR 61	National Emission Standards for Hazardous Air Pollutants (NESHAP)
SUBPART A	General Provisions
SUBPART M	National Emission Standard for Asbestos
40 CFR 763	Asbestos Hazard Emergency Response Act

1.2.2 American National Standards Institute (ANSI)

ANSI Z 9.2	1979 Fundamentals Governing the Design and Operation of Local Exhaust Systems
ANSI Z 88.2	1980 Practice for Respiratory Protection

1.2.3 American Society for Testing Materials (ASTM)

ASTM D 13.31	1956 (Rev. 1980) Surface and Interfacial Tension of Solutions of Surface-Active Agents.
ASTM E 84	1989 (Rev. A) Surface Burning Characteristics of Building Materials
ASTM E 119	1988 Fire Tests of Building Construction and Materials

1.2.4 Underwriters Laboratories (UL)

UL 586 1985 High Efficiency, Particulate, Air Filter Units.

1.2.5 Environmental Protection Agency (EPA)

Guidance for Controlling Asbestos-Containing Materials in Buildings, EPA 560/5085-024, June, 1985.

Asbestos Waste Management Guidance, EPA/530-SW-85-007, May 1985.

Measuring Airborne Asbestos Following an Abatement Action, EPA 600/4-85-049, November 1985.

1.3 REQUIREMENTS

1.3.1 Definitions

Aggressive Methods: Removal or disturbance by sanding, abrading, grinding or other method that breaks, crumbles, or disintegrates intact ACM.

Amended Water: Water containing a wetting agent, or surfactant, designed to allow the water to wet asbestos fibers.

Area Monitoring: Sampling of airborne asbestos fibers inside and outside the Asbestos Regulated Area and which is representative of the airborne concentrations of fibers that may reach the breathing zone of personnel that may be exposed to asbestos.

Asbestos: Fibrous Chrysotile, Amosite, Crocidolite, Tremolite, Anthophylite, and Actinolite; which are naturally occurring minerals.

Asbestos Fibers: Asbestos having a length-to-width ratio of 3:1 or greater and a length of 5 microns or greater.

Authorized Person: A person authorized by the employer and required by work duties to be in the regulated area.

Building/Facility Owner: The legal owner, including a lessee, exercises control over management and record keeping functions

relating to a building/facility in which activities covered by 29 CFR 1926.1101 take place.

Class 1 Work: Activities involving the removal of TSI and surfacing ACM/PACM; "high risk" ACM/PACM.

Class 2 Work: Activities involving the removal of all other ACM/PACM.

Class 3 Work: Repair and maintenance activities where Class 1 & 2 ACM/PACM is likely to be disturbed.

Class 4 Work: Maintenance and custodial activities during which employees contact ACM/PACM; and activities to clean up waste and debris containing ACM/PACM.

Closely Resemble: The major workplace conditions which have contributed to the levels of historic asbestos exposure are no more protective than conditions of the current activity.

Competent Person: 29 CFR 1926.32(f), plus: GENERAL - one who is capable of identifying existing asbestos hazards, able to select the appropriate control strategy, and who has the authority to take prompt corrective measures to eliminate them; CLASS 1 & 2 WORK - specifically trained according to 40 CFR 763 as a Project Designer or Supervisor; CLASS 3 & 4 WORK - specifically trained in an O & M course as per 40 CFR 763.92(a)(2).

Critical Barrier: One or more layers of plastic sheeting or equivalent material placed over openings in the work area, and sufficient to prevent airborne asbestos in the work area from migrating to an adjacent area.

Decontamination Area: An enclosed area adjacent to and connected to the Regulated Area, and consisting of an equipment room, shower area, and clean room, which is used to decontaminate workers, materials and equipment.

Disturbance: Contact with ACM/PACM or debris containing ACM/PACM which releases fibers; activities disrupting the matrix of ACM/PACM, render it friable, or generate visible debris; cutting away small amounts of ACM/PACM to access building components, the amount not to exceed the quantity that can be contained in one standard disposal bag.

Employee Exposure: The concentration of airborne asbestos to which abatement personnel would be exposed if the employee were not wearing respiratory protection equipment.

Friable Asbestos Containing Material: Material containing one percent or more of asbestos by weight; and which can be crumbled, pulverized, or reduced to a powder by hand pressure when dry.

Glovebag: A not more than 60" x 60" impervious plastic bag-like enclosure affixed around an asbestos containing material, with glove-like appendages through which material and tools may be handled.

HEPA Filters: High Efficiency Particulate Air; Filters capable of removing particles with an aerodynamic mass median diameter of 0.3 um with a minimum efficiency of 99.97 percent.

Homogeneous Area: An area of TSI or surfacing material that is uniform in color and texture.

Intact: ACM that has not been crumbled, pulverized, or otherwise deteriorated so that the asbestos is no longer likely to be bound with its matrix.

Local Exhaust System: A system consisting of HEPA-filtered air moving devices used to maintain a static pressure in an enclosed work area that is lower than that of the environment outside the work area.

Modification: A changed or altered procedure, material, or component of a control system that replaces a procedure, material, or component of a required system.

Negative Initial Exposure Assessment: A demonstration by the employer that employee exposure during an activity is expected to be consistently below the PEL and Excursion Limit.

Negative Pressure Enclosure: NPE; A temporary structure made of a double layer of 4- or 6-mil plastic sheeting that encloses the work area, has a restricted entry way, and which is sufficiently sealed to allow depressurization using a local exhaust system.

Non-friable Asbestos Material: Material that contains more than one percent by weight of asbestos, and in which the asbestos fibers are

locked-in and not subject to release in excess of the Permissible Exposure Limit during appropriate use or handling.

Permissible Exposure Limit (PEL): The highest level of employee exposure, as measured by an 8-hour Time Weighted Average, allowed by law. The PEL for asbestos fibers is 0.1 fibers per cubic centimeter of air (0.1 f/cc).

Personal Monitoring: Sampling of airborne asbestos fiber concentrations within the breathing zone of an employee to determine the 8-hour Time Weighted Average. The samples shall be representative of the employee's work tasks; and shall be obtained within 12 inches of the employee's nose or mouth.

PACM: Presumed Asbestos Containing Material; TSI and surfacing material found in buildings constructed before 1980.

Regulated Area: An area surrounding an asbestos abatement project that is isolated by physical barriers and identified by posted signs, to prevent unauthorized entry of personnel, and to prevent the spread of asbestos dust, fibers, or debris.

Standard Disposal Bag: An asbestos disposal bag or glove bag not exceeding 60 inches in length and width.

Surfacing Material: Material that is sprayed-on, troweled-on, or otherwise applied to surfaces (acoustical plaster, fireproofing, etc.).

Surfactant (Wetting Agent): A chemical agent that is added to water to improve the penetration (wetting) of asbestos, which shall be understood to mean a chemical with a surface tension of 29 dynes/cm as tested in accordance with ASTM D 1331. The surfactant shall be a 50/50 mixture of polyoxyethylene ether and polyoxyethylene ester, or equivalent, mixed in a proportion of one fluid ounce to 5 gallons of water, or as specified by the manufacturer.

TSI: Thermal System Insulation; ACM applied to pipes, fittings, boilers, breaching, tanks, ducts, or other components to prevent heat loss/gain.

TWA: Average employee exposure received during an 8-hour work shift.

1.3.2 Title of Materials

All materials resulting from demolition work, except as otherwise specified, shall become the property of the Abatement Contractor and shall be disposed of according to this Plan.

1.3.3 Protection of Existing Work to Remain

The Abatement Contractor shall perform demolition, removal and disposal work without damage or contamination of adjacent work. Where such work is damaged or contaminated, it shall be restored to its original condition or better.

1.3.4 Medical Requirements

1.3.4.1 Medical Examinations

Before abatement personnel are allowed to work in contaminated areas, they shall have an appropriate medical examination in accordance with 29 CFR 1910.134 and 1926.1101; and, in accordance with State and local regulations. Such examinations shall be given on an annual basis to employees engaged in asbestos-related work, and within 30 days after termination of employment in such an occupation.

1.3.4.2 Medical Records

The employee's medical records shall be appropriately identified to the consulting radiologist with the word "ASBESTOS" on the cover. The results of medical examinations shall be retained by the Abatement Contractor for a period of 30 years after the termination of employment. These records shall be available for inspection and copying by the Assistant Secretary of Labor for the Occupational Safety and Health Administration, the Director of the National Institutes of Health, authorized representatives of either agency, and by the employee's physician upon the written request of the employee or former employee.

1.3.5 Training

The South Carolina Department of Health and Environmental Control (SC DHEC) shall accredit all personnel employed by the Abatement Contractor who are involved in asbestos abatement work. Training

shall be in accordance with 29 CFR 1926 and South Carolina state regulations, include a minimum of 32 hours of EPA-accredited instruction, including : (1) all pertinent regulations, (2) health effects of asbestos, (3) proper safety and work procedures, (4) respiratory protection equipment, and (5) decontamination.

Certificates documenting completion of EPA-accredited training for all asbestos workers and supervisors assigned to this project shall be included in the Submittal.

All supervisors on the project shall have a minimum of two years' experience in the administration and supervision of asbestos abatement projects including work practices measures for building personnel, disposal, procedures, etc.

A minimum of one supervisor per work shift shall have attended a 24-hour respiratory protection course.

1.3.6 Permits, Licenses, and Notifications

1.3.6.1 Permits

The Abatement Contractor shall choose the asbestos disposal site. A copy of the landfill permit shall be included in the submittal.

1.3.6.2 State Licenses

The Abatement Contractor shall maintain a current general contractor's license, as well as personal licenses for asbestos supervisors (competent person) and asbestos workers, in accordance with South Carolina Law.

1.3.6.3 Notifications

The Abatement Contractor shall (1) notify the Owner's Representative verbally, three days prior to the start of work, and (2) submit written notifications, as required, prior to the start of work to the appropriate local, state, regional and federal agencies.

Written notifications shall include the following information: (1)Contract number; (2) Name, address, and license number of the Abatement Contractor; (3) The starting date and planned completion date; (4) Project description, including name and location of the building; description of the building - including size, age, and prior

use; approximate amount of ACM to be removed; (5) A description of the abatement methods to be employed; and (6) The procedures to be used to comply with 40 CFR 61, Subparts A, B, and M.

1.3.6.4 OSHA Notification

The Abatement Contractor shall notify OSHA, in advance of performing Class 1 Work, if any intended changes to the use of recognized engineering control systems.

1.3.6.5 Equipment Rental Notification

If rental equipment is to be used during asbestos abatement, handling, or disposal, written notification concerning the intended use of the equipment shall be furnished to the rental agency, with a copy to the Owner's Representative.

1.3.7 Safety and Health Compliance

In addition to the procedures included in this AHAP, the Abatement Contractor shall comply with (1) all laws, ordinances, rules, and regulations of federal, state, regional, and local authorities regarding the handling, storage, transportation, and disposal of asbestos-containing materials, (2) 29 CFR 1910.134 and 1926.1101, and 40 CFR 61 - A, B & M, and (3) 29 CFR 1926.59, including copies of all Material Safety Data Sheets.

The Contractor shall submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting work. The most stringent requirements shall apply should a conflict arise.

The Contractor shall:

1. Comply with OSHA lockout/tagout rules; shall disconnect electrical service when wet removal is performed; and shall use only GFI circuits.

2. Comply with OSHA and confined space entry rules.

3. Comply with OSHA Bloodborne Pathogen rules.

4. Comply with ACGIH cold and heat stress guidelines

5. Prepare fire, accident, and medical emergency response plans. Comply with the applicable recommendations of NFPA Standard 10-Standard for Portable Fire Extinguishers. Locate fire extinguishers where they are most convenient and effective for their intended purpose but provide not less than one extinguisher in each work area equipment room and one in the clean room of the personnel decontamination unit.

6. Prepare contingency plans for electrical power failure and the failure of negative air machines.

7. Supply a minimum of one first aid kit located in the clean room. Additional first aid kits as the contractor feels are adequate or is required by law shall be located throughout the work area.

Abatement personnel shall be informed of the contents of the required compliance plans prior to beginning work.

1.3.8 Hazard Communication

The Abatement Contractor shall comply with the Hazards Communication requirements (1910.1200 and 1926.59). The Owner's Representative shall be supplied with a copy of the Material Safety Data Sheets (MSDS) for all chemicals or substances brought to the job site, including mastic removers.

1.3.8.1 Facility Owner

The building owner shall communicate his knowledge of the presence and location of ACM based on "available" (actual knowledge or the exercise of due diligence) information; and the presence and location of ACM/ PACM unless the facility was built/renovated after 1979:

1. Air monitoring results and locations of remaining ACM/PACM (in the scope of work) shall be submitted to the building/facility owner by the Abatement Contractor within 10 days following completion of abatement work;

2. The Abatement Contractor shall inform the building/facility owner of the location and quantity of any previously unknown ACM/PACM within 24 hours.
It shall be the responsibility of the Abatement Contractor, and all

other employers with employees potentially exposed to asbestos in the event of a breach in a Negative Pressure Enclosure (NPE), to ascertain on a daily basis the integrity of the enclosure and the effectiveness of the control methods.

1.3.8.2 Multi-employer Worksites

An Abatement Contractor performing work requiring the establishment of a regulated area shall inform other employers on the site of the involvement of the work with ACM/PACM; of the existence of and requirements pertaining to regulated areas; and the measures being taken to ensure that employees of other employers are not exposed to asbestos.

Employers of employees who are subject to potential exposure to asbestos on a multi-employer work site shall take measures to protect their employees; including removing the employees from an area until conditions are corrected, and a clearance is obtained; or, performing an initial exposure assessment.

1.3.8.3 General Contractor

The General Contractor on a construction site covered by 29 CFR 1926.1101 shall be deemed to exercise general supervisory authority over the abatement work. The General Contractor shall ascertain whether the Abatement Contractor is in compliance with the OSHA Standard and shall require the Abatement Contractor to come into compliance with the Standard when necessary.

The General Contractor shall be aware that the CIH and the air-monitoring laboratory are subcontractors to the Owner; and the abatement workers are the employees of the Abatement Contractor. It shall be the responsibility of the CIH and/or the air monitoring laboratory to: (1) document work practices that are not in compliance with the OSHA Standard, (2) verbally inform the Competent Person of the non-compliance activity, and (3) inform the Owner of the non-compliance activity. The Owner shall have the authority to issue a stop-work order to employees of the abatement Contractor.

1.3.9 Respiratory Protection Program

The Abatement Contractor shall begin work using a level of respiratory protection consistent with the Initial Exposure Assessment.

If supplied air respirators are used, the contractor shall provide a minimum of Grade D breathing air as set forth in the Compressed Gas Association's Commodity Specifications for Air, G-7.1. The contractor shall test for Grade D breathing air initially and daily thereafter. Daily testing is not needed if the contractor has an air purification system that has CO and organic purging capabilities as well as a continuous CO monitor and alarm calibrated at 10 ppm. The system must be calibrated at least once a week or when it is moved.

Provide emergency backup air supply, egress SCBA or egress HEPA filters for each worker in work area at all times when Type-C (supplied air) respirators are required. Breathing air system shall provide one hour of reserve air, calculated for maximum crew size for emergency evacuation.

Where Type C respirators are utilized, the contractor is required to have an employee in the vicinity of the source of air. The contractor shall take into account the location of the fresh air intake to ensure no pollutant source is in the vicinity. The audible alarm shall be located where the employees inside and outside containment can hear the alarm.

The Abatement Contractor shall have an established Respiratory Protection Program that complies with 29 CFR 1910.134, 29 CFR 1926.1101, and ANSI Z88.2.

The Contractor shall only use respiratory protective equipment certified by NIOSH. Respirator fit testing shall conform to this program.

The type of respirator chosen by the Abatement Contractor shall be in accordance with the minimum respirator selection criteria prescribed in 29 CFR 1926.1101. However, the criteria in Table 1 are recommended for use by the Abatement Contractor after the initial exposure assessment. Respirators and protective clothing shall no longer be required after the Asbestos Control Area has passed both the final visual inspection and the clearance air sampling.

TABLE 1

RESPIRATOR SELECTION CRITERIA

Airborne Concentration of Asbestos	Required Respirator
Not in excess of: 1.0 fibers/cc	Half Face Negative Pressure Respirator, with P-100 Filter Cartridges
Not in excess of: 5.0 fibers/cc	Full-face piece respirator with P-100 Filter Cartridges
Not in excess of: 100.0 fibers/cc	Powered air purifying respirator With p-100 Filter Cartridges
Not in excess of: 100.0 fibers/cc	Full face, positive pressure supplied air, operated in the pressure-demand mode, with HEPA filtered backup source

1.3.10 Masking and Sealing

Establish critical barriers by sealing openings in areas where the release of airborne asbestos fibers is expected. This includes HVAC components, vents, doors, windows, light fixtures, and penetrations. Critical barriers shall consist of two layers of 6-mil fire retardant, re-enforced poly securely fastened to the opening using tape and/or adhesive.

1.3.11 Air Monitoring Laboratory

The Owner’s representative shall be responsible for the coordination and contracting of an industrial hygiene firm. The owner will pay services of the industrial hygiene firm.

The Air monitor shall be accredited as per the SC DHEC program rules.

The industrial hygiene firm shall offer expertise to the owner’s rep. and abatement contractor but is not directly responsible for the performance of the job.

At the job site, the industrial hygiene firm is expected to observe, be aware, and comment on general work site conditions and activities as they relate to the specifications and profession of industrial hygiene and make recommendations in writing to the owner’s rep. and contractor.

The industrial hygiene firm is responsible for overseeing the protection of the environment from contamination, protection of persons in adjacent areas, and assurance that the areas are acceptable for occupancy.

The industrial hygiene firm has the authority to direct the abatement contractor relative to environmental safety concerns. This includes stopping the work if necessary. All directions and comments made by the industrial hygiene firm to the contractor shall be written with a copy to the owner's rep.

The industrial hygiene firm shall furnish the contractor a copy of his field report within 24 hours of the visit. Copies of field notes and reports of observations shall be kept in the project logbook.

The industrial hygiene firm is to conform to the contractor's schedule and shall respond to necessary changes, provided adequate notice is given.

The industrial hygiene firm's project monitor shall furnish owner's rep. and contractor with a pager or mobile phone number where he can be reached quickly at all times.

The industrial hygiene firm shall notify the owner's representative and contractor, in writing, of any failed clearance visits.

Persons performing phase contract microscopy analysis at the asbestos removal location shall be proficient in the American Industrial Hygiene Association's Asbestos Analyst Registry Program (AAR).

If TWA samples are being collected by the contractor for the purpose of reducing respiratory protection requirements, the industrial hygiene firm shall directly observe the conditions and work practices represented by each sample and make appropriate notes on site.

1.3.12 Landfill Approval

An approved landfill shall be selected for the disposal of asbestos waste.

Evidence that the landfill is approved by all applicable regulatory

agencies shall be included in the submittal. Detailed delivery tickets shall be submitted within three (3) days after delivery, or as soon as possible thereafter. The tickets shall be prepared, signed, and dated by an agent of the landfill, and certify the amount of ACM delivered.

1.3.13 Pressure Differential in the Negative Pressure Enclosure (NPE)

A negative pressure differential of at least -0.02 inches of water column shall be maintained between the NPE and adjacent areas.

The pressure differential between the NPE and adjacent areas shall be monitored continuously using a differential pressure monitor supplied by the Abatement Contractor. The air-monitoring technician shall record the pressure reading on the field sheet at least once every two hours during the work shift.

1.3.14 Site Inspection

The Abatement Contractor shall be subject to on-site inspections by the Owner’s Representative, or other safety and health personnel. If any inspection finds the abatement work to be in violation of the specifications in the AHAP, the owner may issue a stop-work order immediately; to be in effect until the status of the violation is resolved. The resulting standby time and expenses required to resolve the violation shall be at the expense of the Abatement Contractor.

1.3.15 Materials

Deliver materials to the job site in original packages and containers. A Material Safety Data Sheet shall accompany all relevant materials. Materials and supplies shall conform to the test requirements mandated by the Specifications prepared by the Owner. The Contractor shall provide a penetrating encapsulant that meets or exceeds the following criteria: (1) Rated "acceptable" when tested under the procedures of "Batelle Columbus Laboratories" for friable ACM, (2) Rated as "acceptable" when field tested in accordance with ASTM P-189, (3) A flame spread index of less than 25 when tested in accordance with ASTM E-84, and (4) Compatibility with the substrate to which it is applied.

PART 2: METHODS OF COMPLIANCE

2.1 GENERAL REQUIREMENTS

The Abatement Contractor shall designate a competent person to be the supervisor at the asbestos control area. The supervisor shall be responsible for performing the following duties:

1. Set up the asbestos control area.
2. Control entry to and exit from the work area.
3. Supervise employee exposure monitoring.
4. Ensure that employees wear personnel protective equipment.
5. Ensure that employees are adequately trained and licensed.
6. Ensure that employees use proper hygiene practices.
7. Ensure that adequate engineering controls are used.

Asbestos abatement work shall be performed in accordance with 29 CFR 1926.1101, and as specified in the AHAP, as follows: use wet removal procedures; personnel shall wear protective clothing, as specified; eating, drinking, or smoking shall not be permitted in the asbestos control area or decontamination unit; shut down, lock-out, and isolate HVAC systems (AHU, intakes, vents, ducts) that supply, exhaust, or pass through the Asbestos Control Area; disconnect electrical service during wet removals and provide electrical service protected by a ground fault interrupter circuit.

Wet asbestos containing material with a fine spray of amended water, other approved wetting agent, or a removal encapsulant during removal, cutting, or other handling to reduce fiber emissions. Immediately place removed asbestos containing material in approved, labeled plastic bags.

Promptly collect asbestos containing waste, scrap, debris, bags, containers, equipment, and contaminated clothing, and seal them in approved, labeled plastic bags. The sealed disposal bags shall be stored and removed from the site in approved and labeled asbestos drums or other approved, enclosed containers.

HEPA vacuum all surfaces and clean all surfaces in the work area using cloth.

A visual inspection shall be performed by the air-monitoring

laboratory to ensure that all visible dust and debris has been removed.

Spray-coat all surfaces in the work area with a binding agent, such as a diluted encapsulant, as appropriate following satisfactory clearance air monitoring results.

The following engineering controls and work practices are either required, prohibited, or required as specified in the AHAP, on all Class 1 work:

2.1.1 Required Methods

Supervision by a Competent Person;
Use of HEPA-filtered vacuum cleaners;
Use of wet methods whenever feasible;
Prompt clean up and disposal of waste and debris.

2.1.2 Specified Methods

Use of a HEPA-filtered local exhaust system;
A regulated area;
Enclosure or isolation of the work area;
Wet methods;
A decontamination area;
A waste load out area

2.1.3 Prohibited Methods

High-speed abrasive disc saws not equipped with HEPA filters;
Use of compressed air on ACM/PACM material, waste or debris;
Dry sweeping of waste and debris;
Employee rotation to reduce employee exposure.

2.1.4 Negative Pressure Enclosure

A minimum of 4 air changes per hour;
A minimum of -0.02 inches of water column, measured;
Negative pressure maintained throughout its use;
Air movement directed away from employees;
Use of HEPA-filtered collection devices;
Inspected, smoke tested, and repaired before each work shift;
Electrical circuits deactivated or equipped with GFI circuits.

A negative pressure enclosure (NPE) shall be established prior to the start of work, as required, using plastic curtains, partitions, or other enclosures in order to prevent (1) contamination of surfaces within the work area, and (2) the escape of asbestos fibers from the contaminated work area.

Openings in the enclosed asbestos work area shall be allowed for worker egress, through the attached decontamination unit, and for the local exhaust system.

2.2 SCOPE OF WORK

Before the asbestos removal begins, critical barriers shall be installed to isolate the work area and create a NPE for all indoors work.

The local exhaust system shall be vented outdoors, and the vent shall terminate at least 20 feet from any occupied building when feasible.

Prior to removal, the HVAC systems that supply, exhaust, or pass through the asbestos work areas shall be shut down and isolated. The intake and exhaust vents and seams of HVAC components in the asbestos work area shall be sealed.

Utilizing wet methods, HEPA vacuuming, wet brushing, and other approved methods, clean all surfaces within the work area of all indoor areas, which shall be visibly clean prior to final clearance sampling. After plastic sheeting is wet-wiped upon completion of asbestos removal, and all areas within the work area are visually clean, the Contractor may apply a lock-down encapsulant. The work area shall be completely dry before clearance testing may begin.

2.2.1 Tar Associated with the Shingle Roof System (**Note: this work shall be performed after final clearance of all indoor work)**

A 50-foot roped off perimeter (regulated area) shall be established around the building prior to commencement of abatement activities, and all other personnel (other than the abatement contractor) shall remain outside the regulated area, and upwind of the work area during abatement. Asbestos danger signs shall be visible on the exterior side of the regulated area from all angles.

All roof-level HVAC intakes, discharges, joints, and penetrations shall be isolated prior to commencement of abatement activities.

The substrates on which the tar is attached shall be removed intact to the extend feasible (i.e., plywood, shingles, etc. with tar attached shall be removed and disposed as one instead of removing the tar from the substrate).

Wet methods (i.e., misting to eliminate dust) shall be used during cutting of non-asbestos materials (i.e., plywood, etc. as needed) and loose dust shall be HEPA-vacuumed immediately.

The roofing materials shall be bagged, wrapped, or placed into other approved containers immediately and removed from the roof through a chute or lowered onto a ground cover prior to the end of the work shift and secured in a waste container for disposal.

2.2.2 Surface Material Associated with Plaster

All surface material associated with plaster walls/ceilings shall be removed with non-mechanical hand tools and wet methods, and immediately placed into plastic bags or other approved containers for disposal. Care shall be taken to contain the water used during the removal process and to avoid undue accumulations of removed asbestos-containing materials and debris.

PART 3 EQUIPMENT

3.1 PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment (PPE) shall be worn by workers and other authorized persons when they are in an asbestos regulated area. PPE shall be worn by all authorized personnel when:

(1) in contact with friable ACM during area preparation,
(2) friable ACM may be disturbed,
(3) within the asbestos regulated area.

The Abatement Contractor shall furnish the Owner’s Representative with four complete sets of PPE daily, as required, for entry into and inspection of the asbestos regulated area. This equipment shall include respirators, disposable protective whole-body coverings, head

coverings, gloves, foot coverings, eye protection, and use of the Contractor's change room. The personal protective equipment shall remain the property of the Abatement Contractor.
The Abatement Contractor shall furnish personnel exposed to airborne concentrations of asbestos fibers greater than or equal to the PEL with disposable protective whole-body clothing, head coverings, gloves, foot coverings, and respirators. Tape shall be used to secure sleeves at the wrists and to secure foot coverings at the ankles. Cloth work clothes may not be worn under disposable protective coveralls.

The Abatement Contractor shall furnish disposable plastic or rubber gloves to protect hands. Cloth gloves may be worn inside plastic or rubber gloves for comfort, but shall not be used alone.

The Abatement Contractor shall furnish goggles for project personnel engaged in asbestos removal operations when the use of a full-face respirator is not required.

3.2 DECONTAMINATION UNIT

The Abatement Contractor shall provide a five chamber Decontamination Unit and a waste load out unit as per the requirement of SC DHEC. The decontamination units shall be connected to the work area for all indoor work.

For work outdoors, the Abatement Contractor shall ensure that: (1) workers HEPA-vacuum and then remove their work suits in the regulated area; and (2) don clean work suits and proceed to the decontamination unit, and shower.

A decontamination unit shall have the following parts: (1) air locks between rooms, (2) dirty room, (3) shower room, (4) clean room, (5) hot and cold running water. The Contractor shall supply dispensable soap and disposable towels.

Shower wastewater shall be handled and disposed of as asbestos containing material; or, shall be filtered through a final filter that has the capability of collecting 0.5 micron or larger particles before disposal into the sanitary sewer system. The final filters shall be handled and disposed of as asbestos containing material.

Backflow prevention shall be provided when connecting the shower to a

potable water supply. The pre-filter and final filter for the shower water shall be located inside the shower room; or, in a location where the wastewater can be contained while changing filters.

3.3 LOCAL EXHAUST SYSTEM

The Abatement Contractor shall provide a local exhaust system in the NPE in accordance with ANSI Z9.2, and as specified in the AHAP.

Filters on vacuums and exhaust equipment shall be absolute HEPA filters and UL 586 labeled or equivalent. Filters shall be replaced as required to maintain the efficiency of the system, and used filters shall be treated as asbestos containing material. Exhaust systems shall be equipped with new HEPA filters for each project and shall comply with ANSI Z9.2-79 and used according to manufacturer's recommendations. Air shall be exhausted outside the building. Any variations must be approved by the SC DHEC. Prior to abatement, demonstrate the system is working properly using visual inspection and smoke tubes.

No portion of the building heating, ventilating, and air conditioning system shall be used as part of the local exhaust system. Care shall be taken to ensure that the exhausted air is released either into an asbestos-free area, or in such a way so as not to disturb any ACM.

The NPE shall be exhausted using approved negative air machines. The number of machines functioning in the asbestos control area shall be sufficient to (1) provide a minimum of one complete air change every 15 minutes, and (2) maintain a minimum pressure differential of negative 0.02 inches of water column relative to the adjacent un-contained areas. The local exhaust system shall be operated continuously, 24 hours a day, until the NPE is removed.
Vacuums and exhaust equipment shall be leak-proof to the filter, which shall be absolute HEPA filters. Filters shall be replaced as required to maintain the efficiency of the system, and used filters shall be treated as ACM. Pre-filters shall be changed when the indicated pressure drop on a negative air machine exceeds 2 inches, or manufacturer's specifications.

3.3.1 Differential Pressures

The Abatement Contractor shall provide a manometer-type or magnehelic-type pressure differential monitor with scale divisions of 0.02 inches

of water and an accuracy within plus or minus one percent. Pressure differential readings shall be obtained within the NPE at the furthest point possible from the local exhaust equipment. Pressure differential readings shall be recorded at the beginning of each shift and at least every two hours thereafter.

3.4 CAUTION SIGNS AND LABELS

3.4.1 Caution Signs

The Abatement Contractor shall provide caution signs, printed in English and Spanish, at approaches to the asbestos control area. A caution sign shall be visible from all points of entry to the building. Signs shall be located at a sufficient distance from the building so that personnel may take the necessary precautions before entering the area.
Caution signs shall be composed as per the specifications contained in 29 CFR 1926.1101, paragraph (k)(6), and shall contain the following language in the format shown:

DANGER
ASBESTOS
CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE CLOTHING
ARE REQUIRED IN THIS AREA

3.4.2 Caution Labels

The Abatement Contractor shall provide caution labels printed in English. The labels shall be affixed to asbestos materials, scrap, waste, debris, sealed impermeable bags, asbestos waste drums, and other asbestos contaminated products. The labels shall be printed with bold print on a contrasting background, displaying the following legend:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD
BREATHING ASBESTOS DUST MAY
CAUSE SERIOUS BODILY HARM

HAZARD SUBSTANCE Transporter: Name & Telephone
CLASS 9 Generating Facility: Name & Address

NA2212, III Date: Loaded
RQ (ASBESTOS)

3.5 EXPOSURE ASSESSMENT AND MONITORING

3.5.1 Assessment

A Competent Person shall conduct an exposure assessment immediately before or at the initiation of the abatement activity to ascertain expected exposures during the activity. The assessment shall provide information necessary to assure that all control systems are appropriate for that activity and will work properly.

The initial exposure assessment shall be based on:

(1) The condition of the ACM/PACM;
(2) Type and amount of asbestos in the ACM;
(3) Location of the ACM (type of substrate or matrix);
(4) Furnishings and equipment to remain in the work area;
(5) Adjacent areas that may be occupied during the activity;
(6) The presence of HVAC components or other critical components;
(7) The abatement method and work practices;
(8) The experience and/or historical data of the work crew.

A Negative Initial Exposure Assessment shall be based on:

(1) objective data demonstrating the material or abatement activity cannot release fibers in excess of the PEL and Excursion Limit under those conditions having the greatest potential for releasing asbestos;

(2) previous monitoring data obtained within the last 12 months during activities which "Closely Resemble" the current activity and that indicate with a high degree of certainty that employee exposures will not exceed the PEL and Excursion Limit; and

(3) initial personal exposure monitoring data on the current activity covering operations most likely to result in exposures over the PEL and Excursion Limit.

The performance of Class 1 Work shall not require the Abatement Contractor to conduct daily personal air monitoring if all employees required to be monitored daily are equipped with supplied-air respirators operated in the positive-pressure mode.

The Abatement Contractor, at the discretion of the Owner's Representative, may terminate personal air monitoring if initial employee exposures obtained during the current activity indicate, by statistically reliable measurement, that employee exposures are below the PEL and Excursion Limit.

However, the employer shall re-instate personal monitoring whenever there has been a change in process, control equipment, personnel, or work practices; independent of a previous Negative Exposure Assessment. Therefore, the Abatement Contractor shall inform the Owner's Representative in writing of any such changes.

Personal samples shall be obtained on at least 25 percent of the abatement workers inside the asbestos control area. An excursion sample, consisting of a 30-minute personal sample obtained during the heaviest portion of the abatement work, shall be obtained during each 4-hour period of the work shift, or as required to monitor potentially excessive exposures.

3.5.2 Air Monitoring Plan

The Abatement Contractor is responsible for personal air monitoring.

Daily personal air monitoring is required unless the Abatement Contractor has made a negative exposure assessment for the entire activity.

The Building Owner is responsible for environmental air monitoring.

An air-monitoring laboratory shall collect environmental air samples. Air samples shall be collected in accordance with the recommendations and procedures described in 29 CFR 1926.1101, the NIOSH 7400 Method (5-15-89), the OSHA Reference Method (ORM), and as specified herein. The concentration of total airborne fibers for personal & environmental samples shall be determined by Phase Contrast Microscopy (PCM) in accordance with the NIOSH 7400 Method (5-15-89) and/or the OSHA Reference Method (ORM).

The laboratory shall perform air monitoring during the work (1) outside the entrance of the NPE, (2) at the discharge of the local exhaust system, (3) at the perimeter of the asbestos regulated area, and (4) at the on-site air monitor's discretion.

If air monitoring outside the asbestos regulated area shows airborne fiber concentrations have reached 0.01 f/cc, the Abatement Contractor shall cease all abatement activities, evacuate personnel from adjacent areas, and attempt to correct the situation. The Owner's representative shall be notified immediately. Work shall not resume until written approval is obtained from the Owners Representative.

The laboratory shall perform TEM clearance monitoring for all indoor work after all surfaces inside the asbestos work area have been cleaned, thoroughly dried, and have passed a final visual inspection. The maximum flow rate shall be 10 liters per minute, with a minimum sample size of 1200 liters for each sample. The establishment of an air concentration of less than or equal to(≤)70 s/m² for each sample shall be required for clearance.

If the air concentration for any clearance sample is greater than 70 s/m², the Abatement Contractor shall re-clean the area and have the testing laboratory repeat the final clearance monitoring. The cost to repeat clearance monitoring shall be absorbed by the Abatement Contractor at the owner's discretion.

3.5.2.1 Air Monitoring Results

Ambient air samples shall be analyzed, and the results shall be made available to the Abatement Contractor and Owner's Representative by the start of the following workday, and shall include the following:

(1) Project Description
(2) Sample Number
(3) Name of Area or Employee/SSN
(4) Location and Task Sampled
(5) TWA Results (f/cc)
(6) Start & Stop Times
(7) Analytical Method
(8) Collection/Analysis Dates

(9) Type of Respirator
(10) Signature of Technician
(11) Signature of Analyst

3.6 CLEANUP AND DISPOSAL

3.6.1 Cleanup

The Abatement Contractor shall: (1) Keep surfaces in the asbestos control area free of accumulations of asbestos containing materials and debris. (2) Keep waste from being distributed over the general area, restricting the spread of dust and debris. Dry sweeping or blowing with compressed air shall not be used on asbestos containing materials.

The Abatement Contractor shall not remove (1) the asbestos control area containment, (2) roped-off perimeter, or (3) caution signs prior to the air monitoring laboratory performing a visual inspection to verify there are no visible accumulations of dust and debris and/or clearance air sampling establishing a TEM airborne asbestos concentration of less than or equal to (≤) 70 s/m².

The Owner's Representative and/or the air monitoring laboratory may visually inspect the affected surfaces for residual asbestos containing material and accumulated dust before and after the containment in the asbestos control area is removed. The Abatement Contractor shall re-clean those areas failing inspection.

The Abatement Contractor shall notify the Owner's Representative before unrestricted entry is permitted.

3.6.2 Removal of Asbestos Waste

The Abatement Contractor shall store asbestos containing waste in a secure area designated by the Owner's Representative.

Asbestos containing waste shall be placed in plastic bags, as specified, and removed from the asbestos control area through the decontamination unit.

The single-bagged waste shall be washed in the shower and

then double-bagged and goose-necked. This process shall require two abatement personnel, one in the dirty room and one in the clean room. A TWA for airborne fibers shall be established during the bagging-out process.

3.6.3 Disposal of Asbestos

The Abatement Contractor shall dispose of asbestos containing waste materials at an approved asbestos landfill. The procedures for hauling and disposal shall comply with all applicable local, state, and regional regulations.

Documentation indicating the proper disposal of the asbestos containing waste at the approved landfill shall be provided to the Owner's Representative within three working days after delivery. The documentation shall include detailed delivery tickets, which have been prepared, signed and dated by an agent of the approved landfill, and certifying the amount of asbestos containing materials delivered to the landfill.

SECTION 030000
SITE CONCRETE

PART 1- GENERAL

1.1 WORK INCLUDED

A. The work included under this section consists of furnishing all material, forms, transportation and equipment, and performing all necessary labor to do all the plain and reinforced concrete work shown on the Drawings or incidental to the proper execution of the work, or as herein specified.
B. Composition: Concrete shall be composed of cement, fine aggregate, coarse aggregate, and water, so proportioned and mixed as to produce a plastic workable mixture in accordance with all requirements under this section suitable to the specific conditions of placement.

1.2 SUBMITTALS

A. All materials specified shall be certified by the producer or manufacturer that the furnished material meets the specific requirements of the specifications.

PART 2- PRODUCTS

2.1 MATERIALS

A. Cement:
   1. Cement: Cement for all concrete shall be domestic Portland cement that conforms to the requirements of ASTM Designation C 150, Type I, Type II or Type III. Type III cement for high early strength concrete shall be used only for special locations and only with the approval of the Engineer. Type III cement shall be used in the construction of sanitary sewer manholes, wet wells and pump stations.
   2. Only one brand of cement shall be used in any individual structure unless approved by the Engineer. Cement which has become damaged, partially set, lumpy or caked shall not be used and the entire contents of the sack or container which contains such cement will be rejected. No salvaged or reclaimed cement shall be used.
B. Fine Aggregate: Fine aggregate shall conform to the requirements of Section 701, of the South Carolina Department of Transportation "Standard Specifications for Highway Construction", latest edition.
C. Coarse Aggregate: Coarse aggregate shall conform to the requirements of Section 701 of the South Carolina Department of Transportation "Standard Specifications for Highway Construction", latest edition, except that slag shall not be used and the gradation shall be grade 57 as approved by the Engineer.
D. Water: Water shall be taken from a potable water supply and shall be fresh, clean and free from injurious amounts of oil, acid, alkali or organic matter.
E. Admixtures: No admixtures shall be used except by specific approval of the Engineer. When approved, admixtures shall meet the following minimum standards.

3. Air entraining agent: ASTM C 260
4. Water reducing and retarding admixture: ASTM C 494, Type D and free of chlorides.

F. Membrane Curing Compound: Membrane curing compound shall conform to the requirements of AASHTO Designation M 148, Type 10-clear, or Type 2-white pigmented.

G. Expansion Joint Filler:
5. Preformed expansion joint filler shall be of the nonextruding and resilient bituminous type and conform to the requirements of AASHTO Designation M 213.
6. Expansion joint filler shall be gray neoprene sponge rubber that conforms to AASHTO Designation M 153, Type I.

H. Separation Board: Separation board shall be closed cell, non-extruding, PVC foam Grade #327 as manufactured by AC Horn, Inc., with a 20 psi maximum compressive strength to compress to 75% of thickness.

I. Membrane: Membrane shall be a 6 mil polyethylene film.

J. Reinforcing Steel:
7. Reinforcing steel shall conform to the requirements of ASTM designation A 615, Deformed Grade 60, except where otherwise indicated.

a. The name of the manufacturer of the reinforcing steel shall be called out in the shop drawings together with a sketch showing the pattern of the deformation, including the mill mark.

b. Bar reinforcement shall be accurately fabricated in accordance with the latest CRSI Manual of Standard Practice. The Contractor shall have prepared and shall submit to the Engineer in sextuplicate, necessary shop drawings and bar lists. The Contractor shall be responsible for error made in shop drawings even though approved by the Engineer.

8. Welded wire fabric for concrete reinforcement shall conform to the requirements of ASTM Designation A 185 and shall be formed with smooth cold-drawn wire.
9. Cold-drawn wire for spirals shall be plain and shall conform to the requirements of ASTM Designation A 82 with a minimum yield strength of 70,000 psi.
10. Bar Supports:

a. Bar supports for reinforcing steel shall conform to the requirements of CRSI Manual of Standard Practice, Chapter 3 and shall be of a height to furnish the concrete cover called for on Drawings. High chairs shall be furnished for bent or top bars in solid slabs. Bar supports to be in contact with exterior surfaces of concrete shall be Class C with plastic caps at least 1-inch in length on the leg tips, or Class E with stainless steel legs. Bar supports shall be spaced not more than 100 times the diameter of the bars to be supported, with not more than 1/4 spacing from the end of the supported bars to the first chair.

b. Bar supports for slabs on grade shall be plain concrete blocks, 3-inches high by 4-inches square with tie wires embedded in support. Concrete strength shall be at 3,000 psi at time of use.

K. Forms: Forms shall be of wood, steel or other approved materials. The sheeting for all exposed surfaces shall be 5-ply plywood, unless otherwise specifically authorized. Forms of like character shall be used for similarly exposed surfaces in order to produce a uniform appearance. Forming for exposed exterior concrete from 1-foot below finished exterior grade to tope of structure shall be carefully fabricated so as to provide a smooth finish without defects. The type, size, shape, quality and strength of all materials of which the forms are made shall be subject to the approval of the Engineer. If it is his opinion that the interior surfaces of the forms are too irregular to produce the specified finish, they shall be lined with smooth, dense, moisture resistant hardboard or other material of which he approved.

L. Nonshrink Grout: Nonshrink grout shall be nonmetallic, pre-mixed type and shall be Sauereisen F-100 Level Fill, Master Builders Masterflow 713, Burke Non-Ferrous, Non-Shrink Grout or approved equal.

2.2 CLASSIFICATION AND STRENGTH OF CONCRETE

A. Class and minimum strength requirements for concrete shall be as tabulated below. Unless otherwise specified, Class A concrete shall be used.

B. Strength Requirements: Concrete class and strength shall meet the minimum compressive strength requirements at the age of 7 and 28 days as shown in the following table. The compressive strengths shall be as determined by standard laboratory cylinder tests in accordance with the procedure set forth in ASTM Designation C 31 and C 39. (See Article 3.03 of this Section for quantity and testing of cylinders.)

Compressive Strength in Pounds Per Square Inch

For Design Class	Purposes	3 Consecutive Cylinder Average 7 Days	3 Consecutive Cylinder Average 28 Days	Low Cylinder 7 Days	Low Cylinder 28 Days
A	4000	2950	4250	2600	3750
B	3000	2100	3200	1850	2800
C	2500	1800	2700	1550	2300

2.3 PROPERTIES AND DESIGN OF CONCRETE MIX

A. Tests and Design Mix:

1. The Contractor, 30 days before the beginning of concrete work, shall advise the Engineer of the proposed sources of the materials, or ready-mixed concrete, which the Contractor intends to use in the work. A design mix which has been used by the concrete supplies before, may be submitted for approval provided the proportions and strengths meet the requirements of this specification.
2. The source and manufacturer of material after once having been approved shall not be changed by the Contractor, except as approved by the Engineer, and additional laboratory tests may be required by the Engineer to prove conformance with specification requirements.
3. If during the progress of the work, tests indicate that concrete is not being produced in accordance with these Specifications the Engineer may order changes in the materials or their proportions so as to secure concrete as specified.

B. Slump: Slumps shall be as low as possible consistent with proper placing. Low slump concrete shall be used for footing and slabs on grade. Medium slump concrete shall be used for walls, columns and suspended slabs. Concrete shall conform to the limits specified in the following schedule:

Class of Concrete	Medium Slump	Low Slump
A	4 to 5 in.	2 to 3 in.
B	4 to 5 in.	2 to 3 in.
C	5 to 6 in.	3 to 4 in.

PART 3- EXECUTION

3.01 PREPARATION

A. Concrete Mixing:

1. Equipment: The Concrete shall be ready-mixed and the equipment shall conform to the applicable requirements of ASTM Designation C 94.
2. Measurement: Equipment necessary to positively determine and control the actual amounts of all materials entering the concrete shall be provided by the Contractor or the concrete manufacturer. All materials shall be measured by weight, except that water may be measured by volume. A bag of cement weighs 94 pounds.

3.02 INSTALLATION

A. Forms:
1. Construction:

a. Forms shall be built true to line and grade, and shall be mortartight and sufficiently rigid to prevent displacement or sagging between supports. Particular attention shall be given to adequacy of supports and shoring, which is the Contractor's

responsibility. The surfaces of forms used for permanently exposed surfaces shall be smooth and free from irregularities, dents, sags, or holes. Forms for surfaces to receive stucco finish shall be suitable for its application. Bolts and rods used for internal ties shall be so arranged that, when the forms are removed, all metal is at least 1 1/2 inch from any concrete surface. form ties shall be removed immediately after removal of forms, and holes shall be thoroughly plugged with grout within 24 hours after form removal and kept damp for 4 days to prevent shrinking.

b. Wire ties will not be permitted. All forms shall be so constructed that they can be removed without hammering or prying against the concrete. Unless otherwise indicated, suitable moldings shall be placed to bevel or round exposed edges at expansion joints or at any other corner that are to remain, beams below grade shall have forms at both sides.

2. Coating: Prior to the placing of steel reinforcement or concrete, forms for exposed surfaces shall be coated with nonstaining paraffin base oil or mineral oil, forms for unexposed surfaces may be thoroughly wetted in lieu of oiling, immediately before the placing of concrete.
3. Removal: Forms and/or form supports shall not be removed from any concrete until it has obtained sufficient strength to support itself and any live loads it may be subjected to, and then only with the approval of the Engineer.

B. Reinforcing Steel: When placed in the forms, reinforcement shall be clean and free of all rust, scale, dust, dirt, paint, oil or other foreign material and shall be accurately and securely positioned in the forms as shown on the Drawings before the placing of concrete. Reinforcing steel shall be wired or otherwise fastened together at intersections and shall be supported by concrete or metal supports, spacers or hangers. Bar supports, where adjacent to the ground, shall be set on precast concrete pads compressed into the subgrade. The Contractor shall obtain the Engineer's approval before fastening reinforcing steel at intersections by welding methods.
   1. Splicing of reinforcement shall be held to a minimum and shall be placed at points of minimum stress. Bars shall be lapped at splices a minimum of 24 bar diameters unless otherwise shown on the Drawings or directed by the Engineer, and shall be rigidly wired or clamped.
   2. Wire fabric shall be straightened before placing and shall overlap one full space of mesh at ends and edges and shall be securely fastened. Fabric shall be supported so as to occupy its proper location in the concrete as shown on the drawings. Fabric shall not cross any expansion joints.

C. Embedded Items: In addition steel reinforcement, pipes, inserts and other metal objects as shown, specified or ordered shall be built into, set in or attached to the concrete. All necessary precautions shall be taken to prevent these objects from being displaced, broken or deformed. Before concrete is placed, care shall be taken to determine that all embedded parts are firmly and securely fastened in place as indicated. They shall be thoroughly clean and free from paint or other coating, rust, scale, oil or any foreign matter. No wood shall be embedded in concrete. The concrete shall be packed tightly around pipes and other metal work to prevent leakage and to secure perfect adhesion. Drains shall be adequately protected from intrusion of concrete.

D. Separation Board: Two inch separation board shall be installed if indicated on the Drawings.

E. Concrete:
   1. General: Reinforcement shall be secured in position, inspected and approved before placing concrete. Runways for transporting concrete shall not rest on reinforcing steel. Concrete not placed within 90 minutes from the time mixing is stated will be rejected and shall be removed from the job by the Contractor. Concrete shall be deposited as nearly as practicable in final position. Concrete shall not be allowed to drop freely more than six feet. All concrete shall be placed in daylight and (excepting seal concrete) shall be placed in the dry unless otherwise authorized by the Engineer in writing.
   2. Compaction: Concrete shall be compacted by internal vibrating equipment, supplemented by hand rodding and tamping as required. Vibrators shall in no case be used to move the concrete laterally inside the forms. Internal vibrators shall maintain a speed of at least 5000 impulses per minute when submerged in concrete. (At least one spare vibrator in working condition shall be maintained at the site during concrete placing operations.) Duration of vibration shall be limited to time necessary to produce satisfactory consolidation without causing segregation. Vibrator shall be moved constantly and placed in each specific spot only once.
   3. Bonding: Before depositing new concrete on or against concrete that has set, the surfaces of the set concrete shall be thoroughly cleaned so as to expose the coarse aggregate and be free of laitance, coatings, foreign matter and loose particles. Forms shall be retightened. The cleaned surfaces shall be dampened, but not saturated, and then thoroughly covered with a coat of cement grout of similar proportions to the mortar in the concrete. The grout shall be as thick as possible on vertical surfaces and at least 1/2-inch thick on horizontal surfaces. The fresh concrete shall be placed before the grout has attained its initial set.
   4. Protection: Rainwater shall not be allowed to increase the ratio of mixing water no to damage the surface finish. Concrete shall be protected form disfigurement, damage, vibration, internal fractures and construction overloads.

F. Curing:
   1. All concrete, including gunite, shall be water cured by covering with a double thickness of clean burlap, cotton mats, or other approved material kept thoroughly saturated with water. The forms shall be kept wet until removed and upon removal, the curing specified herein shall be started immediately. Concrete shall be cured for a period of 7 days for normal Portland cement or 4 days for high early strength cement. Concrete poured in the dry shall not be submerged until it has attained sufficient strength to adequately sustain the stress involved nor shall it be subjected to flowing water across its surface until it has cured 4 days. Curing of gunite shall be started as soon as possible without damaging surface and not later than 2 hours after placing.
   2. In lieu of wet burlap or cotton mats as specified above, concrete slabs may be covered with wet sand and kept moist for the specified curing period. The initial curing period of not less than 24 hours shall consist of the wet burlap or cotton mat method, then the wet sand method may be utilized until the end of the curing period.
   3. Concrete surfaces which will not be coated, painted, plastered, stuccoed, covered with tile or floor covering or requiring a bonding surface may be cured by means of a membrane curing compound in lieu of the wet cure method. The curing compound shall be applied immediately after a satisfactory surface finish has been completed or forms have been removed. The rate of application of membrane curing compound shall be at least one gallon to every 200 square

feet of exposed surface to be cured. The membrane curing compound and impervious covering shall be continuous and without defects and shall retain the required moisture in the concrete. Membrane curing compound that becomes damaged by rain, foot traffic or other conditions within 5 days of application shall be reapplied.

G. Finishes:
   1. As soon as forms can safely be removed, all irregular projections shall be chipped off flush with the concrete surfaces. All voids produced by spacers or any honeycombing shall be pointed up with grout and troweled flush with the concrete surface immediately after removal of forms and water cured to prevent shrinkage. Honeycombing shall be cut out to expose a sound concrete surface prior to pointing. The use of mortar pointing or patching shall be confined to the repair of small defects in relatively green concrete. Where in the opinion of the Engineer substantial repairs are required, the defective concrete shall be cut out to sound concrete and repaired with gunite or the concrete shall be removed and reconstructed as directed.
   2. Floor slabs shall be brought to a true and even finish by power or hand floating in a manner that will not bring excess fines to the surface. The consistency of the concrete shall be such that water does not accumulate at the surface. Unless otherwise shown on the Drawings, the surface shall be floated with a wood float and shall be steel troweled to a smooth finish. Troweling shall be the minimum to obtain a smooth, dense surface and shall not be done until the mortar has hardened sufficiently to prevent excess fine material from being worked to the surface. If so directed, the surface shall be brushed lightly with a push broom so as to produce a nonslip surface.
   3. Concrete surfaces that are not exposed in the completed work will require no special finish other than such pointing up and rubbing as is necessary to leave them smooth and impervious.
   4. Other surfaces which will be exposed in the completed work shall be finished by being rubbed smooth with a float and water or a carborundum brick. The final surface shall be smooth and dense, without pits, irregularities, blow holes or bubbles.

H. Grout:
   1. Grout for pointing and patching shall consist of cement and fine aggregate mixed in the proportions used in the concrete and a minimum amount of water to produce a workable grout.
   2. Material for grouting column base plates, anchor bolts, reinforcing bars, pipe sleeves and pump base plates shall be of the nonshrink type and shall be mixed and placed as recommended by the manufacturer. Machinery set on grout pads shall not be operated until the grout has cured for at least 24 hours.

3.3 FIELD QUALITY CONTROL

A. General: The quality of the concrete as to conformance to the specifications is the entire responsibility of the Contractor until it is accepted in place in the structure and verified by the final cylinder tests made by the laboratory. Arrangements for field testing shall be made by the Contractor with the Owner's Special inspector.

B. Compressive Tests: Standard laboratory compressive test cylinders will be obtained by the laboratory when concrete is discharged from the mixer at the site of the work. A set of 6 cylinders will be obtained for each 60 cubic yards or fraction thereof, placed each day, for each type of concrete. The

cylinders will be cured under laboratory conditions and will be tested in two groups of three at 7 and 28 days of age, respectively.

C. Slump Tests: The laboratory of the Owner or their representative will make slump tests of Class A and Class B concrete as it is discharged from the mixer at the site of the work. Slump tests will be made for each 25 cubic yards or "pour" of concrete placed. Slump tests may be made on any batch and failure to meet specified slump requirements will be sufficient cause for rejection of that batch.

D. Reports: Proper reports of all tests performed by the laboratory will be prepared by the laboratory and submitted promptly to the Special Inspector. Such reports shall be properly labeled so as to identify the portions of the project into which the materials have been placed.

END OF SECTION

SECTION 033000 – CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies cast-in-place concrete, including reinforcement, concrete materials, mix design, placement procedures, and finishes.

1.3 SUBMITTALS

A. General: In addition to the following, comply with submittal requirements in ACI 301.

B. Product Data: For each type of manufactured material and product indicated.

C. Design Mixes: For each concrete mix.

D. Sustainable Design Submittals:
   1. Environmental Product Declaration: For Each Product.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed concrete work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

C. Source Limitations: Obtain each type of cement of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.

D. Comply with ACI 301, "Specification for Structural Concrete", including the following, unless modified by the requirements of the Contract Documents.

   1. General requirements, including submittals, quality assurance, acceptance of structure, and protection of in-place concrete.
   2. Formwork and form accessories.
   3. Steel reinforcement and supports.
   4. Concrete mixtures.
   5. Handling, placing, and constructing concrete.

6. Lightweight concrete.

E. Pre-Installation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings" needed by General Contractor.

PART 2 – PRODUCTS

2.1 FORMWORK

A. Furnish formwork and form accessories according to ACI 301.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

B. Plain-Steel Wire: ASTM A 82, as drawn.

C. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

D. Deformed-Steel Welded Wire Fabric: ASTM A 497, flat sheet.

2.3 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I or III. Only one brand of cement shall be used throughout project.

B. Normal-Weight Aggregate: ASTM C 33, uniformly graded, not exceeding 1-1/2-inch nominal size, class designation 2M.

C. Lightweight Aggregate: ASTM C 330.

D. Water: Potable and complying with ASTM C 94.

E. Reinforcement: Please refer to Structural Drawings.

2.4 ADMIXTURES

A. General: Admixtures certified by manufacturer to contain no more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures. Do not use admixtures containing calcium chloride.

B. Air-Entraining Admixture: ASTM C 260.

C. Water-Reducing Admixture: ASTM C 494, Type A.

D. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.

E. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.

F. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

2.5 RELATED MATERIALS

A. Vapor Retarder: Multi-ply reinforced polyethylene sheet, ASTM E 1745, Class C, not less than 10 mils thick; or polyethylene sheet, ASTM D 4397, not less than 10 mils thick by a company that manufactures vapor retarders/barriers, I.E.: Reef Industries, Stego Industries, Viper, Barrier Bac VB250 11 mil, by Inteplast Group LTD or approved equivalent.

B. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a No. 4 sieve and 10 to 30 percent passing a No. 100 sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

C. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.

2.6 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. dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Solvent-Borne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

G. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

H. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

2.7 CONCRETE MIXES

A. Comply with ACI 301 requirements for concrete mixtures.

B. Prepare design mixes, proportioned according to ACI 301, for normal-weight concrete determined by either laboratory trial mix or field test data bases, as follows:

1. Compressive Strength (28 Days): As noted on drawings
2. Slump: 4 inches. Without plasticizer.

    a. Slump Limit for Concrete Containing High-Range Water-Reducing Admixture: Not more than 8 inches after adding admixture to plant- or site-verified, 2- to 3-inch slump.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 2.5 to 4.5 percent.

1. Air content of trowel-finished interior concrete floors shall not exceed 3.0 percent.

D. Reinforcement: Please refer to Structural Drawings.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with ASTM C 94, and furnish batch ticket information

1. When air temperature is between 85 and 90 deg F, 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. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least one and one-half minutes, but not more than five 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, mix type, mix time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 – EXECUTION

3.1 FORMWORK

A. Design, construct, erect, shore, brace, and maintain formwork according to ACI 301.

3.2 VAPOR RETARDER

A. Install, protect, and repair vapor-retarder sheets according to ASTM E 1643; place sheets in position with longest dimension parallel with direction of pour.

B. Lap joints 6 inches and seal with manufacturers recommended tape.

1. Cover vapor retarder with fine-graded granular material, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch or minus 3/4 inch.

3.3 STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.4 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Locate and install so as not to impair strength or appearance of concrete, at locations indicated or as approved by Architect.

1. Extend joint fillers full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

C. Contraction (Control) 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 the concrete thickness, or 1" whichever is greater, 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.

3.5 CONCRETE PLACEMENT

A. Comply with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.

B. Do not add water to concrete during delivery, at Project site, or during placement.

C. Consolidate concrete with mechanical vibrating equipment.

3.6 FINISHING FORMED SURFACES

A. See drawings for type and location of finishes.

B. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4 inch in height rubbed down or chipped off.

1. Apply to concrete surfaces not exposed to public view.

C. 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 defective areas. Completely remove fins and other projections.

1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.
2. Do not apply rubbed finish to smooth-formed finish.
3. Apply the following rubbed finish, defined in ACI 301, to smooth-formed finished concrete.

a. Smooth-rubbed finish.
b. Grout-cleaned finish.
c. Cork-floated finish.

3.7 FINISHING UNFORMED SURFACES

A. General: Comply with ACI 302.1R for screeding, re-straightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Screed surfaces with a straightedge and strike off. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess moisture or bleed-water appears on the surface.

1. Do not further disturb surfaces before starting finishing operations.

F. Trowel and Fine-Broom Finish: Apply a partial trowel finish, stopping after second troweling, to surfaces indicated and to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set methods. Immediately after second troweling, and when concrete is still plastic, slightly scarify surface with a fine broom.

3.8 TOLERANCES

A. Comply with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials".

B. Finish and measure surface so gap at any point between concrete surface and an unleveled freestanding 10-foot-long straightedge, resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.

3.9 CONCRETE PROTECTION 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 follow recommendations in ACI 305R for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to 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. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.

D. Curing Methods: Cure formed and unformed concrete for at least seven days by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

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. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
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.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement according to requirements specified in this Article. Perform tests according to ACI 301.

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mix placed each day.

3.11 REPAIRS

A. Remove and replace concrete that does not comply with requirements in this Section.

END OF SECTION 033000

SECTION 034900 - GLASS-FIBER-REINFORCED CONCRETE (GFRC)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass-fiber-reinforced concrete (GFRC) panels with panel frames.

a. GFRC panels include column covers, fascia units, cornices, soffits.

1.2 DEFINITIONS

A. Design Reference Sample: Sample of GFRC color, finish, and texture, preapproved by Architect.
B. GFRC Panels: GFRC components, including panel frames, anchors, connections, and integral ribs, as applicable.

1.3 COORDINATION

A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Form liners.
2. Surface retarders.
3. Portland cement.
4. Metakaolin.
5. Glass fibers.
6. Coloring admixture.
7. Polymer-curing admixture.
8. Air-entraining admixture.
9. Chemical admixtures.
10. Stainless steel plate.

11. Stainless steel bars and shapes.
12. Carbon-steel shapes and plates.
13. Carbon-steel bars.
14. Carbon-steel bolts.
15. High-strength bolts, nuts, and washers.
16. Welding electrodes.
17. Cold-formed steel framing.
18. Hollow structural section framing.
19. Steel channel and angle framing.
20. GFRC design mixes.
21. Galvanizing repair paint.

B. Shop Drawings: Show fabrication and installation details for GFRC panels including the following:

1. Panel elevations, sections, and dimensions.
2. Thickness of facing mix, GFRC backing, and bonding pads for typical panels.
3. Finishes.
4. Joint and connection details.
5. Panel corner details.
6. Erection details.
7. Panel frame details for typical panels including sizes, spacings, thicknesses, and yield strengths of various members.
8. Locations and details of connection hardware attached to structure.
9. Sizes, locations, and details of flex, gravity, and seismic anchors for typical panels.
10. Other items sprayed into panels.
11. Erection sequence for special conditions.
12. Relationship to adjacent materials.
13. Description of loose, cast-in, and field hardware.

C. Samples for Verification: Actual sample of finished products representative of GFRC finish, color, and texture variations.

D. Delegated Design Submittals: For GFRC panels, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Sustainable Design Submittals:
1. "Sustainable Design Requirements – Green Globes 2021" to validate the credits claimed to achieve Green Globes goals.
   a. Cradle-to-Gate Product Life Cycle certifications, where available.
   b. Recycled Content:, pre- and post-consumer content, where available.
   c. Sealants: Indicate VOC content.
   d. Environmental Product Declaration: For each product.
2. Laboratory Test Reports: For coatings, indicating compliance with requirements for low-emitting materials.
3. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20.

1.6 INFORMATIONAL SUBMITTALS

A. Certificates:

1. Welding certificates.
2. Steel Sheet Certificates: For steel sheet used in cold-formed steel panel framing, mill certificates signed by manufacturers of steel sheet, or test reports from a qualified testing agency, indicating that steel sheet used in cold-formed metal panel framing complies with requirements including uncoated steel thickness, yield strength, tensile strength, total elongation, chemical requirements, and galvanized-coating thickness.
3. Mill Certificates: For structural-steel shapes and hollow structural sections used in panel framing.

B. Source Quality-Control Submittals:

1. Source Quality-Control Programs: For GFRC manufacturer.

C. Field Quality-Control Submittals:

1. Field quality-control and special inspection reports.

D. Qualification Statements: For GFRC manufacturer.
E. Delegated Design Engineer Qualifications: Include the following:

1. Experience providing delegated design engineering services of the type indicated.
2. Documentation that delegated design engineer is licensed in state where Project is located.

1.7 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturers: Designated a PCI-certified plant for Group G - Glass Fiber Reinforced Concrete, and who employs on Project experienced PCI-certified GFRC testing and inspection personnel, or designated an IAS AC157-certified plant for GFRC, or designated an APA-certified plant for GFRC production.
2. Delegated Design Engineer: A professional engineer who is legally qualified to practice in state where Project is located and who is experienced in providing engineering services of the type indicated.
3. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:

a. AWS D1.1/D1.1M.
b. AWS D1.3/D1.3M.

1.8 MOCKUPS

A. Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and installation.

1. Build mockup as indicated on Drawings.

a. Include typical components, attachments to building structure, and methods of installation.
b. Include window opening with GFRC returns.
c. Include sealant-filled joint complying with requirements in Section 079200 "Joint Sealants."

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Handle and transport GFRC panels supported on nonstaining material and with nonstaining resilient spacers between panels.
B. Store GFRC panels off of ground on firm, level, and smooth surfaces supported on nonstaining material and with nonstaining resilient spacers between panels. Place stored panels so identification marks are clearly visible.

1.10 WARRANTY

A. Special Warranty: Manufacturer and Installer agree to repair or replace components of GFRC panels that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including cracking.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. GFRC Panels:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Advanced Architectural Stone.
    b. GFRC Cladding Systems, LLC.
    c. Stromberg Architectural Products, Inc.

2.2 SOURCE LIMITATIONS

A. Obtain GFRC panels from single manufacturer.

2.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design GFRC panels.

B. Structural Performance: GFRC panels to withstand the following design loads as well as the effects of thermal- and moisture-induced dimensional changes within limits and under conditions indicated:

1. Loads: As indicated on Drawings.
2. Deflection Limits: Design panel frames to withstand design loads without lateral deflections greater than L/240 of wall span.
3. Thermal Movements: Provide for thermal movements resulting from annual ambient temperature changes of 120 deg F (67 deg C).
4. Design panel frames and connections to accommodate deflections and other building movements.

C. Quality-Control Standard: Comply with requirements and recommendations in PCI MNL 130, "Manual for Quality Control for Plants and Production of Glass Fiber Reinforced Concrete Products," unless more stringent requirements are indicated.

D. AISI Specifications: Comply with AISI S100, "North American Specification for the Design of Cold-Formed Steel Structural Members."

E. AISC Specifications: Comply with AISC 360, "Specification for Structural Steel Buildings."

2.4 MOLD MATERIALS

A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that provides continuous GFRC surfaces within tolerances; nonreactive with GFRC and capable of producing required finish surfaces.

1. Mold-Release Agent: Commercially produced liquid-release agent that does not bond with, stain, or adversely affect GFRC surfaces and does not impair subsequent surface or joint treatments of GFRC.

B. Form Liners: Units of face design, texture, arrangement, and configuration indicated. Provide solid backing and form supports to ensure that form liners remain in place during GFRC application. Use with manufacturer's recommended liquid-release agent that does not bond with, stain, or adversely affect GFRC surfaces and does not impair subsequent surface or joint treatments of GFRC.
C. Surface Retarder: Chemical liquid-set retarder capable of temporarily delaying hardening of newly placed GFRC face mix to depth of reveal specified.

2.5 GFRC MATERIALS

A. Obtain each GFRC material of same type, brand, and color from single source or producer.
B. Portland Cement: ASTM C150/C150M; Type I, or III.

1. For surfaces exposed to view in finished structure, use white cement.

C. Metakaolin: ASTM C618, Class N.
D. Glass Fibers: Alkali resistant, with a minimum zirconia content of 16 percent, 1 to 2 inches (25 to 50 mm) long, specifically produced for use in GFRC, and complying with ASTM C1666/C1666M.
E. Backing Sand: Washed and dried silica, complying with composition requirements in ASTM C144; passing a No. 20 (0.85-mm) sieve with a maximum of 2 percent passing a No. 100 (0.15-mm) sieve.
F. Coloring Admixture: ASTM C979/C979M, synthetic mineral-oxide pigments or colored water-reducing admixtures, temperature stable, nonfading, and alkali resistant.
G. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of GFRC and complying with ASTM C1602/C1602M and chemical limits in PCI MNL 130 for nonpotable mixing water.
H. Polymer-Curing Admixture: Acrylic thermoplastic copolymer dispersion complying with PCI MNL 130.
I. Air-Entraining Admixture: ASTM C260/C260M, containing not more than 0.1 percent chloride ions.
J. Chemical Admixtures: ASTM C494/C494M, containing not more than 0.1 percent chloride ions.

2.6 ANCHORS, CONNECTORS, AND MISCELLANEOUS MATERIALS

A. Stainless Steel Plates: ASTM A666, Type 304, Type 316, or Type 201.
B. Carbon-Steel Shapes and Plates: ASTM A36/A36M, finished as follows:

1. Finish: Zinc coated by hot-dip process in accordance with ASTM A123/A123M, after fabrication, or ASTM A153/A153M, as applicable.

C. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 304.

D. Carbon-Steel Bars: ASTM A108, Grade 1018, not less than 1/4 inch (6 mm) in diameter, finished as follows:

1. Finish: Zinc coated by hot-dip process in accordance with ASTM A123/A123M, after fabrication, or ASTM A153/A153M, as applicable.

E. Carbon-Steel Bolts: ASTM A307, Grade A; carbon-steel, hex-head bolts; carbon-steel nuts; and flat, unhardened steel washers, finished as follows:

1. Finish: Zinc coated by hot-dip process in accordance with ASTM A123/A123M, after fabrication, and ASTM A153/A153M, as applicable.

F. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 1, heavy-hex steel structural bolts; ASTM A563 (ASTM A563M), Grade DH (Class 10S) heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers, finished as follows:

1. Finish: Zinc coated by hot-dip process in accordance with ASTM A 123/A 123M, after fabrication, and ASTM A 153/A 153M, as applicable.

G. Welding Electrodes: Comply with AWS standards.

H. Galvanizing Repair Paint: ASTM A 780/A 780M.

2.7 PANEL FRAME MATERIALS

A. Cold-Formed Steel Framing: Manufacturer's standard C-shaped steel studs, complying with AISI S100 with minimum uncoated steel thickness of 0.053 inch (1.35 mm); with stiffened flanges, U-shaped steel track; and of the following steel sheet:

1. Metallic-Coated Steel Sheet: ASTM A653/A653M, structural-steel sheet, G60 (Z180) zinc coating, of grade required by structural performance of framing.
2. Painted, Nonmetallic-Coated Steel Sheet: ASTM A1011/A1011M, hot rolled; or ASTM A1008/A1008M, cold rolled; nonmetallic coated in accordance with ASTM A1003/A1003M; of grade required by structural performance of framing.

B. Hollow Structural Section Framing: Steel tubing, ASTM A500/A500M, Grade B, or ASTM A513/A513M, finished as follows:

1. Finish: Shop primed with organic zinc-rich primer complying with SSPC-Paint 20 on surfaces prepared to comply with SSPC-SP 6/NACE No. 3.

C. Steel Channel and Angle Framing: ASTM A36/A36M, finished as follows:

1. Finish: Shop primed with organic zinc-rich primer complying with SSPC-Paint 20 on surfaces prepared to comply with SSPC-SP 6/NACE No. 3.

2.8 GFRC MIXES

A. Mist Coat: Slurry of portland cement, sand, water, and admixtures; of same proportions as backing mix without glass fibers.
B. Face Mix: Proportion face mix of portland cement, facing aggregates, water, and admixtures to comply with design requirements.
C. Backing Mix: Proportion backing mix of portland cement, glass fibers, sand, water, and admixtures to comply with design requirements. Provide nominal glass-fiber content of not less than 5 percent by weight of total mix.
D. Polymer-Curing Admixture: 6 to 7 percent by weight of polymer-curing admixture solids to dry portland cement.
E. Air Content: 3 to 7-1/2 percent; ASTM C185.
F. Coloring Admixture: Not to exceed 10 percent of cement weight.

2.9 PANEL FRAME FABRICATION

A. Fabricate panel frames and accessories plumb, square, true to line, and with components securely fastened.

1. Fabricate panel frames using jigs or templates.
2. Cut cold-formed metal framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed metal framing members by welding. Comply with AWS D1.3/D1.3M.
4. Fasten framing members of hollow structural sections, steel channels, or steel angles by welding. Comply with AWS D1.1/D1.1M.
5. Weld anchors to panel frames.

B. Reinforce framing assemblies, as necessary, to withstand erection stresses.
C. Galvanizing Repair: Touch up damaged galvanized surfaces in accordance with ASTM A780/A780M.
D. Painting Repair: Touch up damaged painted surfaces using same primer.

2.10 MOLD FABRICATION

A. Construct molds that result in finished GFRC complying with profiles, dimensions, and tolerances indicated, without damaging GFRC during stripping. Construct molds to prevent water leakage and loss of cement paste.

1. Coat contact surfaces of molds with form-release agent.

B. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during GFRC application. Coat form liner with form-release agent.

2.11 GFRC FABRICATION

A. Proportioning and Mixing: For backing mix, meter sand/cement slurry and glass fibers to spray head at rates to achieve design mix proportions and glass-fiber content in accordance with PCI MNL 130 procedures.
B. Spray Application: Comply with spray-up method procedures in accordance with PCI MNL 130.
C. Hand form and consolidate intricate details, incorporate formers or infill materials, and overspray before material reaches initial set to ensure complete bonding.
D. Attach panel frame to GFRC before initial set of GFRC backing, maintaining a minimum clearance of 1/2 inch (13 mm) from GFRC backing, and without anchors protruding into GFRC backing.
E. Build up homogeneous GFRC bonding pads over anchor feet, maintaining a minimum thickness of 1/2 inch (13 mm) over tops of anchor feet, before initial set of GFRC backing. Measure bonding pad thickness at 25 percent of anchor locations.
F. Integral Ribs: Build up homogeneous GFRC integral ribs over expanded polystyrene or polyurethane foam rib formers to comply with design requirements.
G. Inserts and Embedments: Build up homogeneous GFRC bosses or bonding pads over inserts and embedments to provide enough anchorage and embedment to comply with design requirements.
H. Curing: Employ initial curing method that ensures sufficient strength for removing units from mold. Comply with PCI MNL 130 procedures.

    1. Keep moisture off the surfaces of mixes with polymer curing admixtures during the first three hours of curing. Maintain temperature between 60 and 120 deg F (16 and 49 deg C) during the first 16 hours.
    2. Prevent drying of moist curing mixes during the first 24 hours. Maintain units in surface-damp condition at a temperature above 60 deg F (16 deg C) and 95 percent relative humidity for seven days.

I. Panel Identification: Mark each GFRC panel to correspond with identification mark on Shop Drawings. Mark each panel with its casting date.

2.12 FABRICATION TOLERANCES

A. Manufacturing Tolerances: Manufacture GFRC panels so each finished unit complies with PCI MNL 130 dimensional tolerances and the following dimensional tolerances:

1. Overall Height and Width of Units, Measured at the Face Adjacent to Mold:

   a. 10 ft. (3 m) or less, plus or minus 1/8 inch (3 mm).
   b. More than 10 ft. (3 m), plus or minus 1/8 inch per 10 ft. (3 mm per 3 m); 1/4 inch (6 mm) maximum.

2. Edge Return: Plus 1/2 inch (13 mm), minus 0 inch (0 mm).
3. Architectural Facing Thickness: Plus 1/8 inch (3 mm), minus 0 inch (0 mm).
4. Backing Thickness: Plus 1/4 inch (6 mm), minus 0 inch (0 mm).
5. Panel Depth from Face of Skin to Back of Panel Frame or Integral Rib: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).
6. Angular Variation of Plane of Side Mold: Plus or minus 1/32 inch per 3 inches (0.8 mm per 75 mm) of depth, or plus or minus 1/16 inch (1.5 mm) total, whichever is greater.
7. Variation from Square or Designated Skew (Difference in Length of Two Diagonal Measurements): Plus or minus 1/8 inch per 72 inches (3 mm per 1800 mm) or 1/4 inch (6 mm) total, whichever is greater.
8. Local Smoothness: 1/4 inch per 10 ft. (6 mm per 3 m).
9. Bowing: Not to exceed L/240 unless panel complies with erection tolerances using connection adjustments.
10. Length and Width of Block Outs and Openings within One Panel: Plus or minus 1/4 inch (6 mm).
11. Location of Window Opening within Panel: Plus or minus 1/4 inch (6 mm).
12. Maximum Permissible Warpage of One Corner out of the Plane of the Other Three: 1/16 inch per 12 inches (1.5 mm per 305 mm) of distance from nearest adjacent corner, unless panel complies with erection tolerances using connection adjustments.

B. Position Tolerances: Measured from datum line locations, as indicated on Shop Drawings.

1. Panel Frame and Track: Plus or minus 1/4 inch (6 mm).
2. Inserts: Plus or minus 1/2 inch (13 mm).
3. Special Handling Devices: Plus or minus 3 inches (75 mm).
4. Location of Bearing Devices: Plus or minus 1/4 inch (6 mm).
5. Block Outs: Plus or minus 3/8 inch (10 mm).

C. Panel Frame Tolerances: As follows:

1. Vertical and Horizontal Alignment: 1/4 inch per 10 ft. (6 mm per 3 m).
2. Spacing of Framing Member: Plus or minus 3/8 inch (10 mm).
3. Squareness of Frame: Difference in length of diagonals of 3/8 inch (10 mm).
4. Overall Size of Frame: Plus or minus 3/8 inch (10 mm).

2.13 FINISHES

A. Exposed faces to be free of joint marks, grain, and other obvious defects. Corners, including false joints, to be uniform, straight, and sharp.
B. Finish exposed-face surfaces of GFRC to match approved mockups and as follows:
   1. Finish: Provide surfaces to match approved sample for acceptable surface, air voids, sand streaks, and honeycomb, with uniform color and texture.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine structure and conditions for compliance with requirements for installation tolerances, bearing surfaces, and other conditions affecting performance of the Work.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ERECTION

A. Install clips, hangers, and other accessories required for connecting GFRC panels to supporting members and backup materials.
B. Install GFRC panels level, plumb, square, and in alignment. Provide temporary supports and bracing as required to maintain position, stability, and alignment of panels until permanent connections are completed.

   1. Maintain horizontal and vertical joint alignment and uniform joint width.
   2. Remove projecting hoisting devices.

C. Connect GFRC panels in position by bolting or welding, or both, as indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as possible after connecting is completed.
D. Welding: Comply with applicable AWS D1.1/D1.1M and AWS D1.3/D1.3M requirements for welding, appearance, quality of welds, and methods used in correcting welding work.

   1. Protect GFRC panels from damage by field welding or cutting operations, and provide noncombustible shields as required.

E. At bolted connections, use lock washers or other acceptable means to prevent loosening of nuts.

3.3 ERECTION TOLERANCES

A. Erect GFRC panels to comply with the following noncumulative tolerances. For erection tolerances not listed below, comply with PCI MNL 130.

1. Plan Location from Building Grid Datum: Plus or minus 1/2 inch (13 mm).
2. Top Elevation from Nominal Top Elevation:

    a. Exposed Individual Panel: Plus or minus 1/4 inch (6 mm).
    b. Nonexposed Individual Panel: Plus or minus 1/2 inch (13 mm).
    c. Exposed Panel Relative to Adjacent Panel: 1/4 inch (6 mm).
    d. Nonexposed Panel Relative to Adjacent Panel: 1/2 inch (13 mm).

3. Support Elevation from Nominal Elevation:

    a. Maximum Low: 1/2 inch (13 mm).
    b. Maximum High: 1/4 inch (6 mm).

4. Maximum Plumb Variation over the Lesser of Height of Structure or 100 Ft. (30 m): 1 inch (25 mm).
5. Plumb in Any 10 Ft. (3 m) of Element Height: 1/4 inch (6 mm).
6. Maximum Offset in Alignment of Matching Edges: 1/4 inch (6 mm).
7. Face Width of Joint (Governs over Joint Taper):

    a. Panel Dimension 20 Ft. (6 m) or Less: Plus or minus 1/4 inch (6 mm).
    b. Panel Dimension More Than 20 Ft. (6 m): Plus or minus 3/8 inch (9.5 mm).

8. Maximum Joint Taper: 3/8 inch (10 mm).
9. Maximum Joint Taper in 10 Ft. (3 m): 1/4 inch (6 mm).
10. Maximum Offset in Alignment of Matching Faces: 1/4 inch (6 mm).
11. Differential Bowing, as Erected, between Adjacent Members of Same Design: 1/4 inch (6 mm).

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections and prepare reports:

    1. Erection of GFRC panels.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.
C. Visually inspect field welds and test in accordance with ASTM E165/E165M or with ASTM E709 and ASTM E1444/E1444M. High-strength bolted connections are subject to inspections.
D. Testing agency will report test results promptly and in writing to Contractor and Architect.
E. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
F. Additional testing and inspecting, at Contractor's expense, to be performed to determine compliance of replaced or additional work with specified requirements.

3.5 REPAIRS

A. Repairs are permitted provided structural adequacy of GFRC panel and appearance are not impaired, as approved by Architect.
B. Mix patching materials and repair GFRC so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces.
C. Prepare and repair accessible damaged galvanized coatings with galvanizing repair paint in accordance with ASTM A780/A780M.
D. Wire brush and clean accessible weld areas on prime-painted components and paint with same type of shop primer.
E. Remove and replace damaged GFRC panels when repairs do not comply with requirements.

3.6 CLEANING AND PROTECTION

A. Perform cleaning procedures, if necessary, in accordance with GFRC manufacturer's written instructions. Clean soiled GFRC surfaces with detergent and water, using soft fiber brushes and sponges, and rinse with clean water. Prevent damage to GFRC surfaces and staining of adjacent materials.

END OF SECTION 034900

SECTION 042000 - UNIT MASONRY

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 unit masonry assemblies consisting of the following:

1. Concrete masonry units (CMUs).
2. Concrete brick.
3. Mortar and grout.
4. Reinforcing steel.
5. Masonry joint reinforcement.
6. Miscellaneous masonry accessories.

B. Related Sections include the following:

1. Division 01 Section "Sustainable Design Requirements" for LEED requirements pertaining to this Section.
2. Division 05 Section "Metal Fabrications" for furnishing steel lintels and shelf angles for unit masonry.
3. Division 07 Section "Penetration Firestopping" for firestopping at openings in masonry walls.
4. Division 07 Section "Joint Sealants" for sealing control and expansion joints in unit masonry.

1.3 DEFINITIONS

A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.
B. CMU(s): Concrete masonry unit(s).

1.4 PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops indicated net-area compressive strengths (f'_m) at 28 days.

1.5 SUBMITTALS

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

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."

C. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

D. Qualification Data: For Firms and persons specified in "Quality Requirements" article.

E. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:

1. Masonry units.

a. Include material test reports substantiating compliance with requirements.

2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
4. Reinforcing bars.
5. Joint reinforcement.
6. Grout Mixes. Include description of type and proportions of ingredients.

F. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports, per ASTM C 780, for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
2. Include test reports, per ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

G. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

H. Sustainable Design Submittals:
1. Environmental Product Declaration: For Each Product.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for testing indicated, as documented according to ASTM E 548.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.

D. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

E. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects. Comply with requirements in Division 1 Section "Quality Requirements" for mockups.

1. Build sample panels for typical exterior and interior walls in sizes approximately 8' long by 8' high.
2. Clean exposed faces of panels with masonry cleaner indicated.
3. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
    a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by Architect in writing.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches (600 mm) down both sides and hold cover securely in place.
2. Where 1 wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) down face next to unconstructed wythe and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

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

2.2 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not uses units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

2.3 CONCRETE MASONRY UNITS (CMUs)

A. Regional Materials: Provide CMUs that have been manufactured within 500 miles (800 km) of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

B. Shapes: Provide shapes indicated and as follows:

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged units for outside corners, unless otherwise indicated.

C. Concrete Masonry Units: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2000 psi (13.1 MPa).
2. Weight Classification: Lightweight unless otherwise indicated.
3. Size (Width): Manufactured to the following dimensions:

a. 4 inches nominal; 3 5/8 inches actual.
b. 8 inches nominal; 7 5/8 inches actual.
c. 12 inches nominal; 11 5/8 inches actual.

4. Exposed Faces: Manufacturer's standard color and texture.

D. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.4 MORTAR AND GROUT MATERIALS

A. Regional Materials: Provide aggregate for mortar and grout that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

B. Masonry Cement: ASTM C 91.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Holcim (US) Inc.; Mortamix Masonry Cement.
   b. Lafarge North America Inc.; Lafarge Masonry Cement.
   c. Lehigh Cement Company; Lehigh Masonry Cement.

2. Color to be selected by Architect from the manufacture's full color-range of samples

C. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.

D. Aggregate for Grout: ASTM C 404.

E. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Euclid Chemical Company (The); Accelguard 80.
   b. Grace Construction Products, W. R. Grace & Co. - Conn.; Morset.
   c. Sonneborn; Trimix-NCA.

F. Water: Potable.

2.5 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).

B. Masonry Joint Reinforcement, General: ASTM A 951.

1. Interior Walls: Hot-dip galvanized, carbon steel.
2. Exterior Walls: Hot-dip galvanized, carbon steel.
3. Wire Size for Side Rods: W1.7 or 0.148-inch (3.8-mm) diameter.
4. Wire Size for Cross Rods: W1.7 or 0.148-inch (3.8-mm).
5. Wire Size for Veneer Ties: W1.7 or 0.148-inch (3.8-mm) diameter.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (407 mm) o.c.
7. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.
   1. Products:

      a. Dur-O-Wal: DA 3200 Ladur.
      b. Hohmann & Barnard, Inc.: 220 Ladder Mesh.
      c. Approved Equivalent prior to bid.

D. Masonry Joint Reinforcement for Multiwythe Masonry **(at composite site walls only):**

   1. Ladder type with one side rod at each face shell of hollow masonry units more than 4-inches wide, plus one side rod at each wythe of masonry 4 inches wide or less.

   2. Products:

      a. Dur-O-Wal: DA 3200TR Ladur.
      b. Hohmann & Barnard, Inc.: 230 Ladder-Tri-Mesh.
      c. Approved Equivalent prior to bid.

E. Masonry Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.188-inch- (4.8-mm-) diameter, hot-dip galvanized, carbon-steel continuous wire.

2.6 MISCELLANEOUS ANCHORS

A. Anchor Bolts: Headed steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

2.7 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.
B. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

2.8 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

   1. Available Manufacturers:

a. Diedrich Technologies, Inc.
b. EaCo Chem, Inc.
c. ProSoCo, Inc.

2.9 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. For masonry below grade or in contact with earth, use Type S.
2. For reinforced masonry, use Type S.
3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type S.
4. Mix to match Architect's sample.

C. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Provide grout with a slump of 8 to 11 inches (200 to 280 mm) as measured according to ASTM C 143/C 143M.
3. Grout strength to be as indicated on structural Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.

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

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

1. Mix units from several pallets or cubes as they are placed.

F. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:

1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm). Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).
6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm) except due to warpage of masonry units within tolerances specified for warpage of units.

3.3 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches (50 mm). Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

H. Fill cores in hollow concrete masonry units with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
3. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Division 07 Section "Fire-Resistive Joint Systems."

3.4 MORTAR BEDDING AND JOINTING

A. Lay concrete masonry units as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
5. For concrete masonry units, provide bed joint thickness per ACI 530.1 – 3.3B.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.

D. Cut joints flush for masonry walls to receive laminated sheetrock or other direct-applied finishes (other than paint), unless otherwise indicated.

3.5 COMPOSITE MASONRY

A. Bond wythes of composite masonry together using one of the following methods:

1. Masonry Joint Reinforcement: Installed in horizontal mortar joints.

a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.

B. Collar Joints: Solidly fill collar joints by parging face of first wythe that is laid and shoving units of other wythe into place.

C. Corners: Provide interlocking masonry unit bond in each wythe and course at corners, unless otherwise indicated.

D. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, bond walls together as follows:
1. Provide continuity with masonry joint reinforcement by using prefabricated T-shaped units.

3.6 CAVITY WALLS

A. Bond wythes of cavity walls together using one of the following methods:

1. Masonry Joint Reinforcement: Installed in horizontal mortar joints.
a. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties to allow for differential movement regardless of whether bed joints align.
2. Masonry Veneer Anchors: Comply with requirements for anchoring masonry veneers.

B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Strike joints facing cavities flush.

C. Cavity wall insulation and brick veneer seismic anchors/ties provided and installed under Division 07 Section "Thermal Barrier Wall System".

3.7 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).

1. Space reinforcement not more than 16 inches (406 mm) o.c.
2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings.

    a. Reinforcement above is in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.8 ANCHORING MASONRY TO STRUCTURAL MEMBERS

A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:

1. Provide an open space not less than 1 inch (25 mm) in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry to structural members with flexible anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 36 inches (915 mm) o.c. horizontally.

3.9 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry as follows:

1. Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.

C. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 07 Section "Joint Sealants," but not less than 3/8 inch (10 mm).

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.10 LINTELS

A. Install steel lintels where indicated.
B. Provide masonry lintels where shown and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches (200 mm) at each jamb, unless otherwise indicated.

3.11 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

3.12 FIELD QUALITY CONTROL

A. See Division 01 Section "Special Inspections and Testing" for required inspections not listed in this section.

B. Inspectors: Owner will engage qualified independent inspectors to perform inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.

C. Inspections: Level 1 special inspections according to the "International Building Code."

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.

2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

D. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections indicated below and prepare test reports:

1. Payment for these services will be made by Owner.
2. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.

E. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

F. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

G. Testing Frequency: One set of tests for each 5000 sq. ft. (465 sq. m) of wall area or portion thereof.

3.13 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.

6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.14 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Excess Masonry Waste: Remove and legally dispose of off Owner's property.

END OF SECTION 042000

SECTION 042613 - MASONRY VENEER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brick.
2. Mortar materials.
3. Ties and anchors.
4. Embedded flashing.
5. Accessories.
6. Mortar mixes.

B. Products Installed but not Furnished under This Section:

1. Cast-stone trim in masonry veneer.
2. Steel lintels in masonry veneer.

C. Related Requirements:

1. Section 014339 "Mockups" for integrated exterior mockup requirements.
2. Section 076200 "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.2 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Shop Drawings: For the following:

1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special shapes.
2. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Verification: For each type and color of the following:

1. Clay face brick, in the form of straps of five or more bricks.
2. Pigmented and colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project.
3. Weep/cavity vents.
4. Cavity drainage material.
5. Accessories embedded in masonry.

D. Sustainable Design Submittals:
1. "Sustainable Design Requirements – Green Globes 2021" to validate the credits claimed to achieve Green Globes goals.
   a. Cradle-to-Gate Product Life Cycle certifications, where available.
   b. Recycled Content:, pre- and post-consumer content, where available.
   c. Sealants: Indicate VOC content.
   d. Environmental Product Declaration: For each product.
2. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of the following:

1. Masonry units.

   a. Include material test reports substantiating compliance with requirements.
   b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
   c. For exposed brick, include test report for efflorescence in accordance with ASTM C67/C67M.
2. Cementitious materials. Include name of manufacturer, brand name, and type.
3. Mortar admixtures.
4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
5. Anchors, ties, and metal accessories.

B. Mix Designs: For each type of mortar. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Installers: All masonry flashing installers must complete the International Masonry Institute Flashing Upgrade training course.
2. Testing Agency: Qualified in accordance with ASTM C1093 for testing indicated.

1.7 MOCKUPS

A. Wall Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, to set quality standards for materials and execution and to set quality standards for installation. See Section 014339 "Mockups" for additional construction requirements for integrated exterior mockups.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
B. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
C. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.9 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of veneer, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches (610 mm) down face of veneer, and hold cover securely in place.

B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry. Immediately remove grout, mortar, and soil that come in contact with masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. For exposed masonry units and cementitious mortar components, obtain each color and grade from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602, except as modified by requirements in the Contract Documents.
B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects will be exposed in the completed Work and will be within 20 ft. (6 m) vertically and horizontally of a walking surface.

2.3 BRICK

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units.

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Clay Face Brick: Facing brick complying with ASTM C216, Grade SW, Type FBS.
1. Basis of Design: Hanson Brick, Carolina Collection, 605 Modular Waverly Mills, Wirecut Smooth Roller (to match campus brick)
2. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested in accordance with ASTM C67/C67M.
3. Efflorescence: Provide brick that has been tested in accordance with ASTM C67/C67M and is rated "not effloresced."
4. Size (Actual Dimensions): 3-5/8 inches (92 mm) wide by 2-1/4 inches (57 mm) high by 7-5/8 inches (194 mm) long.
5. Application: Use where brick is exposed unless otherwise indicated.

2.4 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content will not be more than 0.1 percent when tested in accordance with ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.
C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
D. Mortar Cement: ASTM C1329/C1329M.
E. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.
F. Colored Cement Products: Packaged blend made from mortar cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
2. Pigments do not exceed 5 percent of mortar cement by weight.

G. Aggregate for Mortar: ASTM C144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch (6.4 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
I. Water: Potable.

2.5 TIES AND ANCHORS

A. General: Ties and anchors extend at least 1-1/2 inches (38 mm) into veneer but with at least a 5/8-inch (16-mm) cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
   1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M, with ASTM A153/A153M, Class B-2 coating.
   2. Galvanized-Steel Sheet: ASTM A653/A653M, Commercial Steel, G60 (Z180) zinc coating.

C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
   1. Tie Section: Triangular-shaped wire tie made from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized steel wire.

D. Adjustable Masonry-Veneer Anchors:

   1. General: Provide anchors that allow vertical adjustment but resist a 100 lbf (445 N) load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch (1.6 mm).
   2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.1084-inch- (2.75-mm-) thick steel sheet, galvanized after fabrication.
   3. Fabricate wire ties from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized steel wire unless otherwise indicated.
   4. Masonry-Veneer Anchors; Single-Barrel Screw: Self-drilling, single-barrel screw designed to receive wire tie. Screw has a smooth barrel the same thickness as insulation with factory-installed gasketed washer to seal at face of insulation and sheathing and a coating to reduce thermal conductivity.

      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) Heckmann Building Products, Inc.
         2) Hohmann & Barnard, Inc.
         3) PROSOCO, Inc.
         4) Wire-Bond.

   5. Stainless Steel Drill Screws for Steel Studs: ASTM C954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 (4.83 mm) diameter by length required to penetrate steel stud flange with not less than three exposed threads; either made from Type 410 stainless steel or made with a carbon-steel drill point and 300 Series stainless steel shank.

2.6 EMBEDDED FLASHING

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch (0.40 mm) thick.
2. Fabricate continuous flashings in sections 96 inches (2438 mm) long minimum, but not exceeding 12 ft. (3.7 m). Provide splice plates at joints of formed, smooth metal flashing.
3. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
4. Fabricate metal drip edges from stainless steel. Extend at least 3 inches (76 mm) into wall and 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
5. Solder metal items at corners.

B. Flexible Flashing: Use the following unless otherwise indicated:

1. Stainless Steel Fabric Flashing: Composite, flashing product consisting of 2 mil (0.05 mm) of Type 304 stainless steel sheet, bonded to a layer of polymeric fabric, to produce an overall thickness of 40 mil (1.0 mm).

C. Basis-of-Design Product: Subject to compliance with requirements, provide York Manufacturing, Inc; Flash Vent SS or a comparable product by one of the following:

1. Hohmann & Barnard, Inc.
2. STS Coatings, Inc.
3. Wire-Bond.

D. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."
1. Elastomeric Sealant: ASTM C920, chemically curing urethane sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and remain watertight.

E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

F. Termination Bars for Flexible Flashing: Stainless steel steel bars 1/8 inch by 1 inch (3.2 mm by 25 mm).

2.7 ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Weep/Vent Products: Use the following unless otherwise indicated:

1. Wicking Material: Absorbent rope, made from cotton, 1/4 to 3/8 inch (6.4 to 10 mm) in diameter, in length required to produce 2-inch (51-mm) exposure on exterior and 18 inches (457 mm) in cavity. Use only for weeps.

2. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch (3.2 mm) less than depth of outer wythe, in color selected from manufacturer's standard.

   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) Advanced Building Products Inc.
      2) Heckmann Building Products, Inc.
      3) Hohmann & Barnard, Inc.
      4) Mortar Net Solutions.
      5) Wire-Bond.

C. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Mortar Deflector: Strips, 3/4 inch (19 mm) thick and 10 inches (254 mm) high, with dovetail-shaped notches that prevent clogging with mortar droppings.

   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) Advanced Building Products Inc.
      2) Hohmann & Barnard, Inc.
      3) Keene Building Products.
      4) Mortar Net Solutions.
      5) Wire-Bond.
      6) York Manufacturing, Inc.

D. Proprietary Acidic Masonry Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

2.8 MORTAR MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime or mortar cement mortar unless otherwise indicated.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Use Type N unless another type is indicated.
D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

1. Pigments do not exceed 10 percent of portland cement by weight.
2. Pigments do not exceed 5 percent of mortar cement by weight.
3. Mix to match Architect's sample.
4. Application: Use pigmented mortar for exposed mortar joints.

E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.

1. Mix to match Architect's sample.
2. Application: Use colored-aggregate mortar for exposed mortar joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2 INSTALLATION, GENERAL

A. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
B. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

D. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested in accordance with ASTM C67/C67M. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch (13 mm) or minus 1/4 inch (6.4 mm).
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (13 mm).
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6.4 mm) in a story height or 1/2 inch (13 mm) total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 ft. (6.4 mm in 3 m), or 1/2-inch (13-mm) maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 ft. (3.2 mm in 3 m), 1/4 inch in 20 ft. (6.4 mm in 6 m), or 1/2-inch (13-mm) maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft. (6.4 mm in 3 m), 3/8 inch in 20 ft. (10 mm in 6 m), or 1/2-inch (13-mm) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 ft. (3.2 mm in 3 m), 1/4 inch in 20 ft. (6.4 mm in 6 m), or 1/2-inch (13-mm) maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft. (6.4 mm in 3 m), 3/8 inch in 20 ft. (10 mm in 6 m), or 1/2-inch (13-mm) maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 ft. (6.4 mm in 3 m), or 1/2-inch (13-mm) maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.6 mm) except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3.2 mm), with a maximum thickness limited to 1/2 inch (13 mm).
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3.2 mm).
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (10 mm) or minus 1/4 inch (6.4 mm).
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3.2 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3.2 mm).
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.6 mm) from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond and Flemish bond (bond pattern indicated on Drawings); do not use units with less-than-nominal 4-inch (102-mm) horizontal face dimensions at corners or jambs.

C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

3.5 MORTAR BEDDING AND JOINTING

A. Lay masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

1. At anchors and ties, fully bed units and fill cells with mortar as needed to fully embed anchors and ties in mortar.

B. Set cast-stone trim units in full bed of mortar with full vertical joints.

1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
2. Allow cleaned surfaces to dry before setting.
3. Wet joint surfaces thoroughly before applying mortar.
4. Rake out mortar joints for pointing with sealant.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.6 ANCHORED MASONRY VENEERS

A. Anchor masonry veneers to wall framing and concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached anchors through sheathing to wall framing with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Embed tie sections in masonry joints.

3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 16 inches (406 mm) o.c. vertically and 16 inches (406 mm) o.c horizontally, with not less than one anchor for each 2.67 sq. ft. (0.25 sq. m) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 36 inches (914 mm), around perimeter.

B. Provide not less than 1 inch (25 mm) of airspace between back of masonry veneer and face of insulation.

1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete to comply with the following:

1. Provide an open space not less than 1 inch (25 mm) wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.

3.8 EXPANSION JOINTS

A. General: Install expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span expansion joints without provision to allow for in-plane wall or partition movement.
B. Form expansion joints as follows:
1. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch (10 mm) for installation of sealant and backer rod specified in Section 079200 "Joint Sealants."

3.9 LINTELS

A. Install steel lintels where indicated.
B. Provide offset angle supports where indicate and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are indicated without structural steel or other supporting lintels.
C. Provide minimum bearing of 8 inches (203 mm) at each jamb unless otherwise indicated.

3.10 FLASHING, WEEP HOLES, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. Extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches (203 mm); with upper edge tucked under air barrier, lapping at least 4 inches (102 mm). Fasten upper edge of flexible flashing to sheathing through termination bar.
3. At lintels and shelf angles, extend flashing 6 inches (152 mm) minimum, to edge of next full unit at each end. At heads and sills, extend flashing 6 inches (152 mm) minimum, to edge of next full unit and turn ends up not less than 2 inches (51 mm) to form end dams.
4. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall, and adhere flexible flashing to top of metal drip edge.

C. Install reglets and nailers for flashing and other related construction where they are indicated to be built into masonry.

D. Install weep holes in veneers in head joints of first course of masonry immediately above embedded flashing.

1. Use specified weep/cavity vent products to form weep holes.
2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
3. Space weep holes 24 inches (610 mm) o.c. unless otherwise indicated.
4. Space weep holes formed from wicking material 16 inches (406 mm) o.c.
5. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.
6. Trim wicking material flush with outside face of wall after mortar has set.

E. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Accessories" Article.

F. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products to form vents.

1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements will be at Contractor's expense.
B. Inspections: Special inspections in accordance with Level 2 in TMS 402.
C. Testing Prior to Construction: One set of tests.
D. Clay Masonry Unit Test: For each type of unit provided, in accordance with ASTM C67/C67M for compressive strength.
E. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, in accordance with ASTM C780.

3.12 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

    1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
    2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
    3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
    4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
    5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
    6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

3.13 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042613

SECTION 047200 - CAST STONE MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall panels.
2. Trim units.
3. Mortar materials.
4. Accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For cast stone units, include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Sustainable Design Submittals:

1. "Sustainable Design Requirements – Green Globes 2021" to validate the credits claimed to achieve Green Globes goals.
   a. Cradle-to-Gate Product Life Cycle certifications, where available.
   b. Recycled Content:, pre- and post-consumer content, where available.
   c. Environmental Product Declaration: For each product.
2. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20.

C. Shop Drawings: Show fabrication and installation details for cast stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.

1. Include building elevations showing layout of units and locations of joints and anchors.

D. Samples for Initial Selection: For colored mortar.

E. Samples for Verification:

1. For each color and texture of cast stone required, 4 inches (100 mm) square in size.
2. For colored mortar, make Samples using same sand and mortar ingredients to be used on Project.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and testing agency.

1. Include copies of material test reports, indicating compliance of cast stone with ASTM C1364.

B. Material Test Reports: For each mix required to produce cast stone, based on testing according to ASTM C1364.

1. Provide test reports based on testing within previous six months.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer of cast stone units similar to those indicated for this Project, that has sufficient production capacity to manufacture required units, and is a plant certified by CSI or APA.
B. Furnish cast stone for installation in mockups specified in Section 014339 "Mockups."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Coordinate delivery of cast stone with unit masonry work to avoid delaying the Work and to minimize the need for on-site storage.
B. Pack, handle, and ship cast stone units in suitable packs or pallets.

1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move cast stone units if required, using dollies with wood supports.
2. Store cast stone units on wood skids or pallets with nonstaining, waterproof covers, securely tied. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.

C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
D. Store mortar aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

1.6 PROJECT CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Comply with cold-weather construction requirements in TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until cast stone has dried, but no fewer than seven days after completing cleaning.

B. Hot-Weather Requirements: Comply with hot-weather construction requirements in TMS 602.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Cast Stone: Obtain cast stone units from single source from single manufacturer.
B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

2.2 CAST STONE MATERIALS

A. General: Comply with ASTM C1364.
B. Portland Cement: ASTM C150/C150M, Type I or Type III, containing not more than 0.60 percent total alkali when tested according to ASTM C114. Provide natural color or white cement as required to produce cast stone color indicated.
C. Coarse Aggregates: Granite, quartz, or limestone complying with ASTM C33/C33M; gradation and colors as needed to produce required cast stone textures and colors.
D. Fine Aggregates: Natural sand or crushed stone complying with ASTM C33/C33M, gradation and colors as needed to produce required cast stone textures and colors.
E. Color Pigment: ASTM C979/C979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
F. Admixtures: Use only admixtures specified or approved in writing by Architect.

1. Do not use admixtures that contain more than 0.1 percent water-soluble chloride ions by mass of cementitious materials. Do not use admixtures containing calcium chloride.
2. Use only admixtures that are certified by manufacturer to be compatible with cement and other admixtures used.
3. Air-Entraining Admixture: ASTM C260/C260M.
4. Water-Reducing Admixture: ASTM C494/C494M, Type A.
5. Water-Reducing, Retarding Admixture: ASTM C494/C494M, Type D.
6. Water-Reducing, Accelerating Admixture: ASTM C494/C494M, Type E.

G. Reinforcement:

1. Deformed steel bars complying with ASTM A615/A615M, Grade 40 (Grade 280). Use galvanized or epoxy-coated reinforcement when covered with less than 1-1/2 inches (38 mm) of cast stone material.
   a. Galvanized Coating: ASTM A767/A767M.
2. Galvanized-Steel, Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from galvanized-steel wire into flat sheets.

3. Fiber Reinforcement: ASTM C1116/C1116M.

H. Embedded Anchors and Other Inserts: Fabricated from steel complying with ASTM A36/A36M and hot-dip galvanized to comply with ASTM A123/A123M.

2.3 CAST STONE UNITS

A. Cast Stone Units: Comply with ASTM C1364.

1. Units are manufactured using the wet-cast method.
2. Wall Panels: Sizes as indicated on Drawings.
3. Trim units including window sills, copings, belt courses, and items as indicated on Drawings.

B. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.

1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
3. Provide drips on projecting elements unless otherwise indicated.

C. Fabrication Tolerances:

1. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8 inch (3 mm).
2. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch (3 mm), whichever is greater, but in no case by more than 1/4 inch (6 mm).
3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch (3 mm), whichever is greater.
4. Location of Grooves, False Joints, Holes, Anchorages, and Similar Features: Do not vary from indicated position by more than 1/8 inch (3 mm) on formed surfaces of units and 3/8 inch (10 mm) on unformed surfaces.

D. Cure Units as Follows:

1. Cure units in enclosed, moist curing room at 95 percent relative humidity and temperature of 100 deg F (38 deg C) for 12 hours or 70 deg F (21 deg C) for 16 hours.
2. Keep units damp and continue curing to comply with one of the following:

   a. No fewer than five days at mean daily temperature of 70 deg F (21 deg C) or above.
   b. No fewer than seven days at mean daily temperature of 50 deg F (10 deg C) or above.

E. Acid etch units after curing to remove cement film from surfaces to be exposed to view.
F. Colors and Textures: Match Architect's samples.

2.4 MORTAR MATERIALS

A. Provide mortar materials that comply with Section 042613 "Masonry Veneer."

2.5 ACCESSORIES

A. Anchors: Type and size indicated, fabricated from Type 304 stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666.
B. Dowels: 1/2-inch- (12-mm-) diameter round bars, fabricated from Type 304 stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666.

2.6 MORTAR MIXES

A. Comply with requirements in Section 042000 "Unit Masonry" for mortar mixes.

2.7 SOURCE QUALITY CONTROL

A. Engage a qualified independent testing agency to sample and test cast stone units according to ASTM C1364.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 SETTING CAST STONE IN MORTAR

A. Set cast stone as indicated in TMS 604.
B. Install cast stone units to comply with requirements in Section 042000 "Unit Masonry."
C. Set cast stone as indicated on Drawings. Set units accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.

1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
2. Coordinate installation of cast stone with installation of flashing specified in other Sections.

D. Wet joint surfaces thoroughly before applying mortar or setting in mortar.

E. Set units in full bed of mortar with full head joints unless otherwise indicated.

1. Set units with joints 3/8 to 1/2 inch (10 to 13 mm) wide unless otherwise indicated.
2. Build anchors and ties into mortar joints as units are set.
3. Fill dowel holes and anchor slots with mortar.
4. Fill collar joints solid as units are set.
5. Build concealed flashing into mortar joints as units are set.
6. Keep head joints in copings and between other units with exposed horizontal surfaces open to receive sealant.
7. Keep joints at shelf angles open to receive sealant.

F. Rake out joints for pointing with sealant to depths of not less than 3/4 inch (19 mm). Scrub faces of units to remove excess mortar as joints are raked.

G. Point joints with sealant to comply with applicable requirements in Section 079200 "Joint Sealants."

1. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.

H. Provide sealant joints at head joints of copings and other horizontal surfaces; at expansion, control, and pressure-relieving joints; and at locations indicated.

1. Keep joints free of mortar and other rigid materials.
2. Build in compressible foam-plastic joint fillers where indicated.
3. Form joint of width indicated, but not less than 3/8 inch (10 mm).
4. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
5. Prepare and apply sealant of type and at locations indicated to comply with applicable

3.3 INSTALLATION TOLERANCES

A. Variation from Plumb: Do not exceed 1/8 inch in 10 ft. (3 mm in 3 m), or 1/2 inch (12 mm) maximum.

B. Variation from Level: Do not exceed 1/8 inch in 10 ft. (3 mm in 3 m), or 1/2 inch (12 mm) maximum.

C. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches (3 mm in 900 mm) or one-fourth of nominal joint width, whichever is less.

D. Variation in Plane between Adjacent Surfaces (Lipping): Do not vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush with units by more than 1/16 inch (1.5 mm), except where variation is due to warpage of units within tolerances specified.

3.4 ADJUSTING AND CLEANING

A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect.
B. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.
C. In-Progress Cleaning: Clean cast stone as work progresses.

1. Remove mortar fins and smears before tooling joints.
2. Remove excess sealant immediately, including spills, smears, and spatter.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed cast stone as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample; leave one sample uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of cast stone.
3. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet surfaces with water before applying cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
5. Clean cast stone by methods described in Cast Stone Institute Technical Bulletin #39.
6. Clean cast stone with proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION 047200

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 Sections:

1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
2. Division 05 Section "Steel Decking" for field installation of shear connectors through deck.
3. Division 05 Section "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame and other metal items not defined as structural steel.
4. Division 05 Section "Metal Stairs."
5. Division 09 painting Sections for surface-preparation and priming requirements.

1.3 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.4 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 design 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.

1.5 SUBMITTALS

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

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. For structural-steel connections indicated to comply with design loads, include structural design data.

C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint qualified by testing.

D. Qualification Data: For qualified Installer, fabricator and testing agency.

E. Welding certificates.
F. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

G. Mill test reports for structural steel, including chemical and physical properties.
H. Product Test Reports: For the following:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength bolt-nut-washer assemblies.
4. Shear stud connectors.
5. Shop primers.
6. Nonshrink grout.

I. Source quality-control reports.
J. Sustainable Design Submittals:
1. Environmental Product Declaration: For Each Product.

1.6 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.

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1 or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

D. 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. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

E. 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."

1.7 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.

1.8 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' 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.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992/A 992M.

B. Channels, Angles, M, S-Shapes: ASTM A 36/A 36M.

C. Plate and Bar: ASTM A 36/A 36M.

D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.

E. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.

1. Weight Class: Standard, UNO.
2. Finish: Black except where indicated to be galvanized.

F. Welding Electrodes: Comply with AWS requirements.

2.2 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. Headed Anchor Rods: ASTM F 1554, Grade 36, straight, Unless Noted Otherwise.

1. Nuts: ASTM A 563 heavy-hex carbon steel.
2. Plate Washers: ASTM A 36/A 36M carbon steel.
3. Washers: ASTM F 436, Type 1, hardened carbon steel.
4. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C

C. 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: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.

2.3 PRIMER

A. Primer: Comply with Division 09 painting Sections.

2.4 GROUT

A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and 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. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural steel. Straighten as required to provide uniform, square, and true members in completed wall framing.

H. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing 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.

2.6 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: Snug tightened.

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 will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.7 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 to be high-strength bolted with slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.
6. Top surface of composite beams.

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 as applicable:

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."
3. SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning."
4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
5. SSPC-SP 14/NACE No. 8, "Industrial Blast Cleaning."
6. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
7. SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning."
8. SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning."
9. SSPC-SP 8, "Pickling."

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.

2.8 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.

1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize lintels, shelf angles, and welded door frames attached to structural-steel frame and located in exterior walls.

2.9 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected 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 will not be accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.

2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

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. Base, Bearing and Leveling 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.
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's "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 will be 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.

H. 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.

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.

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 where indicated, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Bolted Connections: Bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.

1. In addition to visual inspection, field welds will be tested and inspected 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 will not be accepted.
    c. Ultrasonic Inspection: ASTM E 164.
    d. Radiographic Inspection: ASTM E 94.

D. 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 on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

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.

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 Division 09 painting Sections.

END OF SECTION 051200

SECTION 054400 - PRE-ENGINEERED COLD-FORMED STEEL TRUSSES

PART 1 GENERAL

1.2 RELATED SECTIONS

A. Section 05 30 00 - Metal Decking.

B. Section 05 40 00 - Cold Formed Metal Framing.

1.3 DEFINITIONS

A. Truss Component Manufacturer: The maker of the components that will be assembled into trusses by the Truss Manufacturer. See MANUFACTURERS for acceptable Truss Component Manufacturer.

B. Truss Design Drawing: Written, graphic and pictorial depiction of an individual truss.

C. Truss Design Engineer: Person who is licensed to practice engineering as defined by the legal requirements of the jurisdiction in which the building is to be constructed and who supervises the preparation of the truss design drawings. In this case, the Truss Design Engineer is the Truss Component Manufacturer.

D. Truss Placement Diagram: Illustration identifying the assumed location of each Truss.

1.4 REFERENCES

A. ANSI/AISI/ S100-2012: North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012 edition.

B. ANSI/AISI /S200-12: North American Standard for Cold-Formed Steel Framing - General Provisions; 2012 edition.

C. ANSI/AISI/S202-11: Code of Standard Practice for Cold-Formed Steel Structural Framing; 2011 edition.

D. ANSI/AISI /S214-12: North American Standard for Cold-Formed Steel Framing - Truss Design; 2012 edition.

E. ASTM A 370-14 - Standard Test Methods and Definitions for Mechanical Testing of Steel Products; 2014.

F. ASTM A 500-13 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.

G. ASTM A 653-15 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

H. ASTM A 780-09 (2015) – Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings; 2009 and reapproved in 2015.

I. CFSBCSI - Cold-Formed Steel Building Components Safety Information; Cold-Formed Steel Council (CFSC); 2008 edition with insert for Modifications to Chapters CFSB1, B2, & B3.
J. CFSEI Technical Note 551e - Design Guide for Permanent Bracing of Cold-Formed Steel Trusses; Cold-Formed Steel Engineers Institute; February 1998.

1.5 SUBMITTALS

A. Submit under provisions of Section 01 30 00.
B. Product Data: Truss Component Manufacturer's descriptive literature for each item of cold-formed metal framing and each accessory specified in this section.
C. Truss Design Drawings: Detailed drawings prepared by Truss Manufacturer under the supervision of the Truss Design Engineer that are in accordance with AISI references. These drawings may also include referenced detail drawings germane to the trusses.
D. Truss Placement Diagram: Diagram that identifies the assumed location of each individually designated truss and references the corresponding Truss Design Drawing.
E. Installation Instructions: Truss Component Manufacturer's printed instructions for handling, storage, and installation of each item of cold-formed metal framing and each accessory specified in this section.
F. Sustainable Design Submittals:
1. Environmental Product Declaration: For Each Product.

1.6 QUALITY ASSURANCE

A. Provide design of trusses by Truss Component Manufacturer, using design methodologies recommended in AISI references.
1. Determine mechanical properties of load bearing components by testing in accordance with ASTM A 370-14.
2. Provide drawings by a Registered Design Professional licensed in the State in which project is to be constructed.
3. Provide Truss Manufacturer's Truss Design Drawings.

B Pre-Installation Meeting: Meet at job site prior to scheduled beginning of installation to review requirements:
1. Review potential interface conflicts; coordinate layout and support provisions.

1.7 DELIVERY, STORAGE, AND HANDLING OF STEEL TRUSSES

A. Pack, ship, handle, unload, and lift shop products in accordance with Truss Component Manufacturer's recommendations and in manner necessary to prevent damage or distortion.
B. Store and protect products in accordance with Truss Component Manufacturer's recommendations and in manner necessary to prevent damage, distortion and moisture buildup.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Truss Manufacturers: Truss components shall be fabricated into completed trusses by fabricators that have at least 5 years worth of experience in the design and supply of Cold-Formed Steel Trusses.

1. All substitutions must be approved in writing by the Architect or Building Designer.

2.2 COMPONENTS

A. Pre-Engineered, Pre-Fabricated Cold-Formed Steel Trusses.

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1. Truss Type, Span, and Height: As indicated on drawings.
2. Deflection Under All Loads: 1/240th of span, maximum.
3. Deflection Under Live Loads: 1/180th of span, maximum.
4. Shop fabricate in accordance with Truss Design Drawings, using jigging systems to ensure consistent component placement and alignment of components, and to maintain specified tolerances; field fabrication is strictly prohibited unless performed by authorized Truss Manufacturer using Truss Manufacturer's shop assemblers and proper jigging systems.
5. Shop fabrication of other cold-formed steel framing components into assemblies prior to erection is permitted; fabricate assemblies in accordance with shop drawings.
6. Fasten connections within truss assembly with Truss Component Manufacturer's screws only and as shown on the Truss Design Drawings; welding and other fasteners are prohibited.
7. Fabricate straight, level, and true, without rack, and to the tolerances specified in ANSI/AISI /S214-12:

B. Truss Chord and Web Components: All truss components to be symmetrical in profile and loading orientation, with rolled or closed edges to minimize the danger of cutting during handling; chord and web components without rolled edges are prohibited.

1. Shapes, Sizes, and Thicknesses: As required to suit design and as indicated on shop drawings.
2. Chords: Cold-formed from ASTM A 653/A 653M galvanized steel sheet, minimum G60 coating; minimum yield strength of 55,000 psi (380 MPa) for 22, 20, 18 and 16 GA components or 50,000 psi (345 MPa) for 14 GA and 12 GA components; minimum tensile strength of 65,000 psi (448 MPa) for 22, 20, 18, 16, 14, and 12 GA components.
    a. Nominal 28 mil (22 GA) members:
        1. Minimum bare metal thickness: 0.0284 inch (0.72 mm).

2. Maximum design thickness: 0.0299 inch (0.76 mm).

b. Nominal 33 mil (20 GA) members:

1. Minimum bare metal thickness: 0.0329 inch (0.84 mm).
2. Maximum design thickness: 0.0346 inch (0.88 mm).

c. Nominal 43 mil (18 GA) members:

1. Minimum bare metal thickness: 0.0428 inch (1.09 mm).
2. Maximum design thickness: 0.0451 inch (1.15 mm).

d. Nominal 54 mil (16 GA) members:

1. Minimum bare metal thickness: 0.0538 inch (1.37 mm).
2. Maximum design thickness: 0.0566 inch (1.44 mm).

e. Nominal 68 mil (14 GA) members:

1. Minimum bare metal thickness: 0.0677 inch (1.72 mm).
2. Maximum design thickness: 0.0713 inch (1.81 mm).

f. Nominal 97 mil (12 GA) members:

1. Minimum bare metal thickness: 0.0966 inch (2.46 mm).
2. Maximum design thickness: 0.1017 inch (2.58 mm).

3. Tube Webs: Cold-formed ASTM A500 steel structural tubing; minimum yield strength of 45,000 psi (310 MPa); minimum tensile strength of 55,000 psi (380 MPa).

a. Nominal 33 mil (20 GA) members:

1. Minimum bare metal thickness: 0.033 inch (0.84 mm).
2. Maximum design thickness: 0.035 inch (0.89 mm).

b. Nominal 47 mil (18 GA) members:

1. Minimum bare metal thickness: 0.047 inch (1.19 mm).
2. Maximum design thickness: 0.049 inch (1.24 mm).

c. Nominal 63 mil (16 GA) members:

1. Minimum bare metal thickness: 0.063 inch (1.6 mm).
2. Maximum design thickness: 0.065 inch (1.65 mm).

4. Rolled formed Webs: Cold-formed from ASTM A 653/A 653M galvanized steel sheet, minimum G60 coating; minimum yield strength of 40,000 psi (276 MPa) for 20 and 18 GA components or 50,000 psi (345 MPa) for 16 GA components; minimum tensile

strength of 55,000 psi (379 MPa) for 20 and 18 GA components or 65,000 psi (448 MPa) for 16 GA components.

a. Nominal 33 mil (20 GA) members:
1. Minimum bare metal thickness: 0.0329 inch (0.84 mm).
2. Maximum design thickness: 0.0346 inch (0.88 mm).

b. Nominal 43 mil (18 GA) members:
1. Minimum bare metal thickness: 0.0428 inch (1.09 mm).
2. Maximum design thickness: 0.0451 inch (1.15 mm).

c. Nominal 54 mil (16 GA) members:
1. Minimum bare metal thickness: 0.0538 inch (1.37 mm).
2. Maximum design thickness: 0.0566 inch (1.44 mm).

C. Fasteners Used in Fabricating Trusses: Fasteners as recommended by Truss Component Manufacturer, bearing stamp of Truss Component Manufacturer for ready identification.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that bearing surfaces and substrates are ready to receive steel trusses.

B. Verify that truss bearing surfaces are within the following tolerances:
1. Variation from Level or Specified Plane: Maximum 1/8 inch in 10 feet (6 mm in 3 m).
2. Variation from Specified Position: Maximum 1/4 inch (6 mm).

C. Verify that rough-in utilities and chases that will penetrate plane of trusses are in correct locations and do not interfere with truss, bracing, or bridging placement.

D. Inspect conditions under which installation is to be performed and submit written notification if such conditions are unacceptable to installer.
1. Notify Architect/Building Designer within 24 hours of inspection.
2. Beginning construction activities of this section before unacceptable conditions have been corrected is prohibited.
3. Beginning construction activities of this section indicates installer's acceptance of conditions.

3.2 INSTALLATION

A. Install trusses in accordance with Truss Component Manufacturer's instructions and Truss Manufacturer's Truss Design Drawings and Truss Placement Diagram. Use correct fasteners as previously described.

B. Place components at spacings indicated on the Truss Design Drawings.

C. Install all erection (temporary installation) bracing and permanent bracing and bridging before application of any loads; follow recommendations of the CFSBCSI - Cold-Formed Steel Building Components Safety Information.

D. Install erection bracing - follow recommendations of the CFSBCSI - Cold-Formed Steel Building Components Safety Information.

1. Provide bracing that holds trusses straight and plumb and in safe condition until decking and permanent truss bracing has been fastened to form a structurally sound framing system.
2. All sub-contractors shall employ proper construction procedures to insure adequate distribution of temporary construction loads so that the carrying capacity of any single truss or group of trusses is not exceeded.

E. Install permanent bracing and bridging as shown in the Architect/Building Designer's drawings and notes and in the locations shown shown on the Truss Manufacturer's Truss Design Drawings.

F. Removal, cutting, or alteration of any truss chord, web or bracing member in the field is prohibited, unless approved in advance in writing by the Architect/Building Designer and the Truss Design Engineer.

G. Repair or replace damaged chords, webs, and complete trusses as directed and approved in writing in advance by the Architect/Building Designer and the Truss Component Manufacturer.

3.3 FIELD QUALITY CONTROL

A. Owner will provide inspection service to inspect field connections; see Section 01 40 00.

3.4 REPAIRS AND PROTECTION

A. Galvanizing repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel trusses with gavanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions in a manner acceptable to the manufacturer and installer, that ensure the cold-formed steel trusses are without damage or deterioration at the time of substantial completion.

END OF SECTION 054400

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous framing and supports.
2. Metal ladders.
3. Metal ships' ladders and pipe crossovers.
4. Elevator pit sump covers.
5. Metal downspout boots.

B. Related Requirements:

1. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
2. Section 051200 "Structural Steel Framing" for steel framing, supports, elevator machine beams, hoist beams, divider beams, door frames, and other steel items attached to the structural-steel framing.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data:
1. Shop primers.
2. Shrinkage-resisting grout.
3. Slotted channel framing.
4. Manufactured metal ladders.
5. Metal ships' ladders and pipe crossovers.
6. Metal downspout boots.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Miscellaneous framing and supports for applications where framing and supports are not specified in other Sections.
2. Elevator machine beams, hoist beams, and divider beams.
3. Steel shapes for supporting elevator door sills.
4. Metal ladders.
5. Metal ships' ladders and pipe crossovers.
6. Elevator pit sump covers.

C. Delegated Design Submittals: For ladders and stairs, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Sustainable Design Submittals:
1. Environmental Product Declaration.
2. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20.
3. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)

1.4 INFORMATIONAL SUBMITTALS

A. Mill Certificates: Signed by stainless steel manufacturers, certifying that products furnished comply with requirements.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Research Reports: For post-installed anchors.

E. Delegated design engineer qualifications.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders and stairs.
B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
C. Stainless Steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, Type 304.
D. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 304.
E. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.
F. Rolled-Stainless Steel Floor Plate: ASTM A793.
G. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.
H. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.
I. Zinc-Coated Steel Wire Rope: ASTM A741.
J. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

1. Size of Channels: 1-5/8 by 1-5/8 inches (41 by 41 mm).
2. Galvanized Steel: ASTM A653/A653M, commercial steel, Type B, with G90 (Z275) coating; 0.108-inch (2.8-mm) nominal thickness.

K. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless steel fasteners for fastening aluminum stainless steel or nickel silver.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A (ISO 898-1, Property Class 4.6); with hex nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.

C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, (ASTM A563M, Class 10S3) heavy-hex carbon-steel nuts; and where indicated, flat washers.

D. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593 (ISO 3506-1); with hex nuts, ASTM F594 (ASTM F836M); and, where indicated, flat washers; Alloy Group 1 (A1).

E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

F. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.

G. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.

H. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting." And Section 099123 "Interior Painting."

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer that contains pigments that make it easily distinguishable from zinc-rich primer.

C. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.
D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
H. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
I. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
D. Form exposed work with accurate angles and surfaces and straight edges.
E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated with attached bearing plates, anchors, and braces as indicated. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

D. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.

1. Provide bearing plates welded to beams where indicated.
2. Drill or punch girders and plates for field-bolted connections where indicated.
3. Where wood nailers are attached to girders with bolts or lag screws, drill or punch holes at 24 inches (600 mm) o.c.

E. Galvanize miscellaneous framing and supports where indicated.

F. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 METAL LADDERS

A. General:
1. For elevator pit ladders, comply with ASME A17.1/CSA B44.

B. Steel Ladders:

1. Space siderails 16 inches (406 mm) apart unless otherwise indicated.
2. Siderails: Continuous, 3/8-by-2-1/2-inch (9.5-by-64-mm) steel flat bars, with eased edges.
3. Rungs: 3/4-inch- (19-mm-) diameter, steel bars.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
6. Source Limitations: Obtain nonslip surfaces from single source from single manufacturer.
7. Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 1/2 inch (12 mm) in least dimension.
8. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets.
9. Galvanize and prime ladders, including brackets.

2.8 METAL SHIPS' LADDERS AND PIPE CROSSOVERS

A. Provide metal ships' ladders where indicated. Fabricate of open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.

1. Treads are not to be less than 5 inches (127 mm) exclusive of nosing or less than 8-1/2 inches (216 mm) including the nosing, and riser height is not to be more than 9-1/2 inches (241 mm).
2. Fabricate ships' ladders, including railings from steel.
3. Fabricate treads and platforms from welded or pressure-locked steel bar grating. Limit openings in gratings to no more than 1/2 inch (12 mm) in least dimension.
4. Comply with applicable railing requirements in Section 055213 "Pipe and Tube Railings."

B. Galvanize and primesteel ships' ladders, including treads, railings, brackets, and fasteners.

2.9 ELEVATOR PIT SUMP COVERS

A. Fabricate from welded or pressure-locked steel bar grating. Limit openings in gratings to no more than 1/2 inch (12 mm) in least dimension.

B. Provide steel angle supports unless otherwise indicated.

2.10 METAL DOWNSPOUT BOOTS

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. J.R. Hoe & Sons Inc.
2. Neenah Foundry Company.

B. Source Limitations: Obtain downspout boots from single source from single manufacturer.
C. Provide downspout boots made from cast iron in heights indicated with inlets of size and shape to suit downspouts. Provide units with flanges and holes for countersunk anchor bolts.

1. Outlet: Vertical, to discharge into pipe.

D. Prime cast-iron downspout boots with zinc-rich primer.

2.11 GENERAL FINISH REQUIREMENTS

A. Finish metal fabrications after assembly.
B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.12 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with universal shop primer unless indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
4. Other Steel Items: SSPC-SP 3, "Power Tool Cleaning."
5. Galvanized-Steel Items: SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.13 ALUMINUM FINISHES

A. As-Fabricated Finish: AA-M12.
B. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLATION OF METAL LADDERS

A. Secure ladders to adjacent construction with the clip angles attached to the stringer.
B. Install brackets as required for securing of ladders welded or bolted to structural steel or built into masonry or concrete.

3.3 INSTALLATION OF METAL SHIPS' LADDERS AND PIPE CROSSOVERS

A. Secure top and bottom of ships' ladders to construction to comply with manufacturer's written instructions.

3.4 INSTALLATION OF ELEVATOR PIT SUMP COVERS

A. Install tops of elevator sump pit cover plates and frames flush with finished surface. Adjust as required to avoid lippage that could present a tripping hazard.

3.5 INSTALLATION OF METAL DOWNSPOUT BOOTS

A. Anchor metal downspout boots to concrete or masonry construction to comply with manufacturer's written instructions.
B. Secure downspouts terminations to downspouts and substrate per manufacturer's instructions.

3.6 REPAIRS

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

a. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting." And Section 099123 "Interior Painting."

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055000

SECTION 055113 - METAL PAN STAIRS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preassembled steel stairs with concrete-filled treads.
2. Steel tube railings and guards attached to metal stairs.
3. Steel tube handrails attached to walls adjacent to metal stairs.
4. Guardrails

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for metal stairs, railings, and guards.

1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, blocking for attachment of wall-mounted handrails, and items with integral anchors, that are to be embedded in concrete or masonry.
2. Deliver such items to Project site in time for installation.

C. Coordinate locations of hanger rods and struts with other work so they do not encroach on required stair width and are within fire-resistance-rated stair enclosure.

D. Schedule installation of railings and guards so wall attachments are made only to completed walls.

1. Do not support railings and guards temporarily by any means that do not satisfy structural performance requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For metal pan stairs and the following:
1. Shop primer products.
2. Handrail wall brackets.
3. Grout.

B. Sustainable Design Submittals:
1. Environmental Product Declaration.

2. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20.
3. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)

C. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.
2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
3. Include plan at each level.
4. Indicate locations of anchors, weld plates, and blocking for attachment of wall-mounted handrails.

D. Delegated Design Submittal: For stairs, railings and guards,, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that engineer is licensed in the State in which Project is located.
B. Welding certificates.
C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.
B. 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."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification.

1. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers.
2. Protect steel members and packaged materials from corrosion and deterioration.
3. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures.

a. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stairs, railings and guards,, including attachment to building construction.

B. Structural Performance of Stairs: Metal stairs withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing and guard loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch (6.4 mm), whichever is less.

C. Structural Performance of Railings and Guards: Railings and guards, including attachment to building construction, withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:
    a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
    b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
    c. Uniform and concentrated loads need not be assumed to act concurrently.
2. Infill of Guards:
    a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
    b. Infill load and other loads need not be assumed to act concurrently.
3. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
    a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. Seismic Performance of Stairs: Metal stairs withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Component Importance Factor: 1.0

2.2 METALS

A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
C. Steel Tubing for Railings and Guards: ASTM A500/A500M (cold formed) or ASTM A513/A513M.
D. Steel Pipe for Railings and Guards: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
E. Uncoated, Cold-Rolled Steel Sheet: ASTM A1008/A1008M, either commercial steel, Type B, or structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.
F. Uncoated, Hot-Rolled Steel Sheet: ASTM A1011/A1011M, either commercial steel, Type B, or structural steel, Grade 30 (Grade 205), unless another grade is required by design loads.

2.3 FASTENERS

A. General: Provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5 where built into exterior walls.

    1. Select fasteners for type, grade, and class required.

B. Fasteners for Anchoring Railings and Guards to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings and guards to other types of construction indicated and capable of withstanding design loads.
C. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
D. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.

    1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for exterior stairs.

E. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

    1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless steel bolts, ASTM F593, and nuts, ASTM F594 (ASTM F836M).

2.4 MISCELLANEOUS MATERIALS

A. Handrail Wall Brackets: Cast stainless steel, center of rail 2-1/2 inches (63.5 mm) from face of wall.
B. Welding Electrodes: Comply with AWS requirements.
C. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
D. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish system indicated.
F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
H. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for exterior use; noncorrosive and nonstaining; mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, railings and guards, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.

B. Assemble stairs, railings, and guards in shop to greatest extent possible.

1. Disassemble units only as necessary for shipping and handling limitations.
2. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated.

2. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
E. Form exposed work with accurate angles and surfaces and straight edges.
F. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously unless otherwise indicated.
5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 - No evidence of welded joint.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.

1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
2. Locate joints where least conspicuous.
3. Fabricate joints that will be exposed to weather in a manner to exclude water.
4. Provide weep holes where water may accumulate internally.

2.6 FABRICATION OF STEEL-FRAMED STAIRS

A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Architectural Class, unless more stringent requirements are indicated.
B. Stair Framing:

1. Stringers: Fabricate of steel channels or steel rectangular tubes as indicated on Drawings.

a. Stringer Size: As required to comply with "Performance Requirements" Article and As indicated on Drawings.
b. Provide closures for exposed ends of channel and rectangular tube stringers.
c. Finish: Shop primed.

2. Platforms: Construct of steel plate or steel channel or steel rectangular tube headers and miscellaneous framing members as required to comply with "Performance Requirements" Article and indicated on Drawings.

a. Provide closures for exposed ends of channel and rectangular tube framing.
b. Finish: Galvanized.

3. Weld stringers to headers; weld framing members to stringers and headers.

4. Where stairs are enclosed by gypsum board assemblies, provide hanger rods or struts to support landings from floor construction above or below.

    a. Locate hanger rods and struts where they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.

5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch (1.7 mm).

1. Fabricate treads and landing subplatforms of exterior stairs so finished walking surfaces slope to drain.
2. Steel Sheet, Uncoated: Cold-rolled steel sheet unless otherwise indicated.
3. Galvanized Steel Sheet: Galvanized steel sheet, exterior stairs.
4. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
5. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.

    a. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.

2.7 FABRICATION OF STAIR RAILINGS AND GUARDS

A. Fabricate railings and guards to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of member, post spacings, wall bracket spacing, and anchorage, but not less than that needed to withstand indicated loads.

B. Welded Connections: Fabricate railings and guards with welded connections.

1. Fabricate connections that are exposed to weather in a manner that excludes water.

    a. Provide weep holes where water may accumulate internally.

2. Cope components at connections to provide close fit, or use fittings designed for this purpose.
3. Weld all around at connections, including at fittings.
4. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
5. Obtain fusion without undercut or overlap.
6. Remove flux immediately.
7. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 - No evidence of a welded joint as shown in NAAMM AMP 521.

C. Form changes in direction of railings and guards as follows:

1. As detailed.
2. By bending.

D. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

E. Close exposed ends of railing and guard members with prefabricated end fittings.

F. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.

1. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

G. Connect posts to stair framing by direct welding unless otherwise indicated.

H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.

1. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
2. For galvanized railings and guards, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.
3. For nongalvanized railings and guards, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.
4. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.

I. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports.

1. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.8 FINISHES

A. Finish metal stairs after assembly.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
2. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

C. Preparation for Shop Priming: Prepare uncoated, ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
D. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedments for compliance with requirements.

1. For wall-mounted railings, verify locations of concealed reinforcement within gypsum board and plaster assemblies.

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

3.2 INSTALLATION OF METAL PAN STAIRS

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.

1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

1. Grouted Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates.

a. Clean bottom surface of plates.
b. Set plates for structural members on wedges, shims, or setting nuts.
c. Tighten anchor bolts after supported members have been positioned and plumbed.
d. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
e. Promptly pack grout solidly between bearing surfaces and plates so no voids remain.

1) Neatly finish exposed surfaces; protect grout and allow to cure.

2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
3. Comply with requirements for welding in "Fabrication, General" Article.

F. Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete."

3.3 INSTALLATION OF RAILINGS AND GUARDS

A. Adjust railing and guard systems before anchoring to ensure matching alignment at abutting joints with tight, hairline joints.

1. Space posts at spacing indicated or, if not indicated, as required by design loads.
2. Plumb posts in each direction, within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
3. Align rails and guards so variations from level for horizontal members and variations from parallel with rake of stairs for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).
4. Secure posts, rail ends, and guard ends to building construction as follows:

a. Anchor posts to steel by welding to steel supporting members.
b. Anchor handrail and guard ends to concrete and masonry with steel round flanges welded to rail and guard ends and anchored with post-installed anchors and bolts.

B. Install railing gates level, plumb, and secure for full opening without interference.

1. Attach hardware using tamper-resistant or concealed means.
2. Adjust hardware for smooth operation.

C. Attach handrails to wall with wall brackets.

1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
2. Secure wall brackets to building construction as required to comply with performance requirements.

a. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
b. For hollow masonry anchorage, use toggle bolts.

c. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
d. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.
e. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.4 REPAIR

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

   a. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

B. Repair of Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055113

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood products.
2. Wood-preservative-treated lumber.
3. Miscellaneous lumber.
4. Plywood backing panels.

B. Related Requirements:
1. Section 061600 "Sheathing" for sheathing, subflooring, and underlayment.

1.2 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.
B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) size or greater but less than 5 inches nominal (114 mm actual) size in least dimension.
C. Exposed Framing: Framing not concealed by other construction.
D. Lumber grading agencies, and abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NLGA: National Lumber Grades Authority.
3. SPIB: The Southern Pine Inspection Bureau.
4. WCLIB: West Coast Lumber Inspection Bureau.
5. WWPA: Western Wood Products Association.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.

B. Sustainable Design Submittals:

1. Environmental Product Declaration: For each product.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates:

1. For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
2. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained.

1.5 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS

A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.

B. Maximum Moisture Content:

1. Boards: 15 percent.
2. Dimension Lumber: 15 percent for 2-inch nominal (38-mm actual) thickness or less; 19 percent for more than 2-inch nominal (38-mm actual) thickness unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1, Use categories as follows:

1. UC1: Interior construction not in contact with ground or subject to moisture. Include all rough carpentry.
2. UC2: Interior construction not in contact with ground but may be subject to moisture. Include all rough carpentry.

3. UC3A (Commodity Specification A): Coated sawn products in exterior construction not in contact with ground but exposed to all weather cycles including intermittent wetting. Include all rough carpentry.
4. UC3A (All Other Commodity Specifications): Coated products excluding sawn products in exterior construction not in contact with ground, exposed to all weather cycles but protected from liquid water. Include all rough carpentry.
5. UC3B (Commodity Specification A): Uncoated sawn products in exterior construction not in contact with ground, exposed to all weather cycles including intermittent wetting but with sufficient air circulation for wood to dry. Excludes sawn products not in contact with ground but with ground contact-type hazards. Include all rough carpentry.
6. UC3B (All Other Commodity Specifications): Uncoated products excluding sawn products in exterior construction not in contact with ground, exposed to all weather cycles including prolonged wetting. Include all rough carpentry.
7. UC4A (All Other Commodity Specifications): Non-critical products excluding sawn products in contact with ground and exposed to all weather cycles, normal exposure conditions. Include all rough carpentry.
8. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

2.3 MISCELLANEOUS LUMBER

A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any of the following species:
1. Mixed southern pine or southern pine; SPIB.

2. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
D. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.4 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

2.5 FASTENERS

A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F1667.
C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 as appropriate for the substrate.

2.6 MISCELLANEOUS MATERIALS

A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.

1. Verify adhesives have a VOC content of 70; g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify building concentration of formaldehyde does not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and acetaldehyde concentration does not exceed 9 mcg/cu. m.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate nailers, blocking,and similar supports to comply with requirements for attaching other construction.
B. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.
C. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.

D. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
E. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

F. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
G. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.10.1, "Fastening Schedule," in ICC's International Building Code (IBC).
2. ICC-ES evaluation report for fastener.

H. Securely attach roofing nailers to substrates by anchoring and fastening to withstand bending, shear, or other stresses imparted by Project wind loads and fastener-resistance loads as designed in accordance with ASCE/SEI 7.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach wood blocking to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
C. Attach wood roofing nailers securely to substrate to resist the designed outward and upward wind loads indicated on Drawings and in accordance with ANSI/SPRI ED-1, Tables A6 and A7.

END OF SECTION 061000

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Roof sheathing.
3. Parapet sheathing.
4. Composite nail base insulated roof sheathing.
5. Sheathing joint-and-penetration treatment materials.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for plywood backing panels.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review air-barrier and water-resistant glass-mat gypsum sheathing requirements and installation, special details, transitions, mockups, air-leakage testing, protection, and work scheduling that covers air-barrier and water-resistant glass-mat gypsum sheathing.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Wall sheathing.
2. Roof sheathing.
3. Parapet sheathing.
4. Composite nail base insulated roof sheathing.
5. Sheathing joint-and-penetration treatment materials.

B. Product Data Submittals: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.

3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency in accordance with ASTM D5516.
4. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. For air-barrier and water-resistant glass-mat gypsum sheathing, include manufacturer's technical data and tested physical and performance properties of products.

C. Sustainable Design Submittals:
1. "Sustainable Design Requirements – Green Globes 2021" to validate the credits claimed to achieve Green Globes goals.
   a. Cradle-to-Gate Product Life Cycle certifications, where available.
   b. Recycled Content:, pre- and post-consumer content, where available.
   c. Sealants: Indicate VOC content.
   d. Environmental Product Declaration: For each product.

2. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
3. VOC Content for each product
4. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.
B. Product Test Reports: For each air-barrier and water-resistant glass-mat gypsum sheathing assembly, indicating compliance with specified requirements, for tests performed by a qualified testing agency.
C. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated plywood.
2. Fire-retardant-treated plywood.
3. Foam-plastic sheathing.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications:

1. For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested in accordance with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 WOOD PANEL PRODUCTS

A. Emissions: Products are to meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
B. Certified Wood: Certify the following wood products in accordance with the American Tree Farm System's "AFF Standard," the AF&PA's Sustainable Forestry Initiative, FSC STD-01-001 and FSC STD-40-004, or the standards of the Programme for Endorsement of Forest Certification.

1. Plywood.
2. Oriented strand board.
3. Particleboard underlayment.
4. Hardboard underlayment.

C. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
D. Factory mark panels to indicate compliance with applicable standard.

2.3 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.4 FIRE-RETARDANT-TREATED PLYWOOD

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested in accordance with ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

    1. Use treatment that does not promote corrosion of metal fasteners.
    2. Exterior Type: Treated materials are to comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering in accordance with ASTM D2898. Use for exterior locations and where indicated.
    3. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested in accordance with ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
    4. Design Value Adjustment Factors: Treated lumber plywood is to be tested in accordance with ASTM D5516 and design value adjustment factors are to be calculated in accordance with ASTM D6305. Span ratings after treatment are to be not less than span ratings specified.

C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.
D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.
E. Application: Treat plywood indicated on Drawings, and the following:

    1. Roof and wall sheathing within 48 inches (1220 mm) of fire walls.
    2. Roof sheathing.

2.5 WALL SHEATHING

A. Glass-Mat Gypsum Sheathing, Walls: ASTM C1177/C1177M.

    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        a. CertainTeed Corporation; Saint-Gobain North America.

b. Georgia-Pacific Gypsum LLC.
c. National Gypsum Company.
d. USG Corporation.

2. Type and Thickness: Regular, , 5/8 inch (15.9 mm) thick.
3. Size: 48 by 96 inches (1219 by 2438 mm) for vertical installation.

B. Cementitious Backer Units, Walls: ASTM C1325, Type A.
1. Thickness: 5/8 inch (15.9 mm)

2.6 PARAPET SHEATHING

A. Plywood Sheathing, Parapets: Either DOC PS 1 or DOC PS 2, Exterior, Structural I sheathing.

1. Span Rating: Not less than 16/0.
2. Nominal Thickness: Not less than 3/4" inch

B. Glass-Mat Gypsum Sheathing, Parapets: ASTM C1177/C1177M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed Corporation; Saint-Gobain North America.
b. Georgia-Pacific Gypsum LLC.
c. National Gypsum Company.
d. USG Corporation.

2. Type and Thickness: Type X, 5/8 inch (15.9 mm) thick.
3. Size: 48 by 96 inches (1219 by 2438 mm) for vertical installation.

2.7 COMPOSITE NAIL BASE INSULATED ROOF SHEATHING

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. Atlas Roofing Corporation; Basis of Design "CrossVent".
b. Cornell Corporation.
c. Dow Chemical Company (The).
d. Johns Manville; Berkshire Hathaway Inc.
e. Rmax, Inc.

2. Polyisocyanurate-Foam Thickness: 3-1/2 inches (89 mm).
3. Oriented-Strand-Board Nominal Thickness: 7/16 inch (11.1 mm).

4. R-value: 23
5. Overall panel thickness: 6 inches.
6. Integral Air Space: 1.5 inches.

2.8 FASTENERS

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

1. For roof parapet and wall sheathing, provide fasteners of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F1667.
C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
D. Screws for Fastening Sheathing to Wood Framing: ASTM C1002.
E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.

1. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C1002.
2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, use screws that comply with ASTM C954.

G. Screws for Fastening Composite Nail Base Insulated Roof Sheathing to Metal Roof Deck: Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours in accordance with ASTM B117. Provide washers or plates if recommended by sheathing manufacturer.

2.9 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

B. Sheathing Tape for Foam-Plastic Sheathing: Pressure-sensitive plastic tape recommended by sheathing manufacturer for sealing joints and penetrations in sheathing.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.10.1, "Fastening Schedule," in the ICC's International Building Code.
2. ICC-ES evaluation report for fastener.

D. Coordinate wall, parapet and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 INSTALLATION OF WOOD STRUCTURAL PANEL

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
B. Fastening Methods: Fasten panels as indicated below:

1. Wall and Roof Sheathing:
   a. Screw to cold-formed metal framing.
   b. Space panels 1/8 inch (3 mm) apart at edges and ends.

3.3 INSTALLATION OF GYPSUM SHEATHING

A. Comply with GA-253 and with manufacturer's written instructions.
   1. Fasten gypsum sheathing to cold-formed metal framing with screws.
   2. Install panels with a 3/8-inch (9.5-mm) gap where non-load-bearing construction abuts structural elements.

3. Install panels with a 1/4-inch (6.4-mm) gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.

1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of panels.
2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

D. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.

1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of panels.
2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

E. Seal sheathing joints in accordance with sheathing manufacturer's written instructions.

1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

3.4 INSTALLATION OF CEMENTITIOUS BACKER UNITS

A. Install panels and treat joints in accordance with ANSI A108.11 and manufacturer's written instructions for type of application indicated.

END OF SECTION 061600

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior standing and running trim for transparent finish.
2. Interior standing and running trim for opaque finish.
3. Interior frames and jambs for transparent finish.
4. Preservative-treated wood material.
5. Miscellaneous materials.
6. Shop priming.
7. Shop finishing.
8. Accessories.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing interior architectural woodwork that are concealed within other construction before interior architectural woodwork installation.
2. Section 062023 "Interior Finish Carpentry" for interior carpentry exposed to view that is not specified in this Section.
3. Section 123661.16 "Solid Surfacing Countertops"
4. Section 123661.19 "Quartz Agglomerate Countertops"

1.2 COORDINATION

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

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Anchors.
2. Adhesives.
3. Shop finishing materials.

B. Wood-Preservative Treatment:

1. Include data and warranty information from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
2. Indicate type of preservative used and net amount of preservative retained.
3. Include chemical-treatment manufacturer's written instructions for finishing treated material and manufacturer's written warranty.

C. Waterborne Treatments: For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

D. Sustainable Design Submittals:

1. Environmental Product Declaration: For each product.
2. Third-Party Certifications: For each product.
3. Third-Party Certified Life Cycle Assessment: For each product.
4. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
5. For products containing composite wood, provide copies of product labels, chain of custody records or documentation demonstrating compliance with CARB./ATCM formaldehyde regulation.
6. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20.

E. Shop Drawings:

1. Include the following:

   a. Dimensioned plans, elevations, and sections.
   b. Attachment details.

2. Show large-scale details.
3. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.

F. Samples: For each exposed product and for each shop-applied color and finish specified.

1. Size:

   a. Panel Products: 12 inches by 12 inches (300 mm by 300 mm).
   b. Lumber Products: Not less than 5 inches (125 mm) wide by 12 inches (300 mm) long, for each species and cut, finished on one side and one edge.

G. Samples for Verification: For the following:

1. Lumber for Transparent Finish: Not less than 5 inches (125 mm) wide by 12 inches (300 mm) long, for each species and cut, finished on one side and one edge.
2. Veneer Leaves: Representative of and selected from flitches to be used for transparent-finished interior architectural woodwork.

3. Lumber and Panel Products with Shop-Applied Opaque Finish: 5 inches (125 mm) wide by 12 inches (300 mm) long for lumber and 8 by 10 inches (200 by 250 mm) for panels, for each finish system and color.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.
B. Product Certificates: For the following:

1. Composite wood products.
2. Adhesives.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
   1. Installer Qualifications: Licensed participant In AWI's Quality Certification Program.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups of typical interior architectural woodwork as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Architectural Woodwork Standards, Section 2.
B. Do not deliver interior architectural woodwork until painting and similar finish operations that might damage woodwork have been completed in installation areas.
C. Store woodwork in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1. Handle and store fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions.

1.8 FIELD CONDITIONS

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

B. Environmental Limitations with Humidity Control: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 43 and 70 percent during the remainder of the construction period.

C. Field Measurements: Where interior architectural woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being concealed by construction, and indicate measurements on Shop Drawings.

D. Established Dimensions: Where interior architectural woodwork is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Frames: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.

B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing in accordance with NFPA 257 or UL 9.

2.2 ARCHITECTURAL WOODWORK, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1. The Contract Documents contain requirements that are more stringent than the Architectural Woodwork Standards. Comply with Contract Documents and Architectural Woodwork Standards.

B. Certified Wood: Certify wood products in accordance with the American Tree Farm System's "AFF Standard," the AF&PA's Sustainable Forestry Initiative, FSC STD-01-001 and FSC STD-40-004, or the standards of the Programme for Endorsement of Forest Certification.

C. Composite Wood Products: Comply with California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or provide products made with no added formaldehyde.

2.3 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

A. Architectural Woodwork Standards Grade: Premium.

B. Hardwood Lumber:

1. Wood Species and Cut: Match species and cut indicated for other types of transparent-finished architectural woodwork located in same area of building unless otherwise indicated.
2. Species: Select White Maple.
3. Cut: plain sliced.
4. Wood Moisture Content: 8 to 13 percent.
5. For trim items other than base wider than available lumber, use veneered construction. Do not glue for width.
6. For base wider than available lumber, glue for width. Do not use veneered construction.
7. For rails thicker than available lumber, use veneered construction. Do not glue for thickness.

2.4 INTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

A. Architectural Woodwork Standards Grade: Premium.

1. Wood Species: Any closed-grain hardwood.
2. Wood Moisture Content: 8 to 13 percent.

2.5 INTERIOR FRAMES AND JAMBS FOR TRANSPARENT FINISH

A. Architectural Woodwork Standards Grade: Premium.

B. Wood Species and Cut: Match species and cut indicated for other types of transparent-finished architectural woodwork located in same area of building unless otherwise indicated.

1. Wood Moisture Content: 8 to 13 percent.

C. For frames or jambs wider than available lumber, use veneered construction. Do not glue for width.

1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches (76 mm) wide.

2.6 HARDWOOD SHEET MATERIALS

A. Composite Wood Products: Provide materials that comply with requirements of the Architectural Woodwork Standards for each type of interior architectural woodwork and quality grade specified unless otherwise indicated.
1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
2. Particleboard: ANSI A208.1, Grade M-2.
3. Softwood Plywood: DOC PS 1, medium-density overlay.
4. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

2.7 PRESERVATIVE-TREATED-WOOD MATERIAL

A. Preservative-Treated-Wood Materials: Provide with water-repellent preservative treatment complying with AWPA N1 (dip, spray, flood, or vacuum-pressure treatment).

1. Preservative Chemicals: 3-iodo-2-propynyl butyl carbamate (IPBC), combined with a compatible EPA-registered insecticide.
2. Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.

B. Extent of Preservative-Treated Wood Materials: Treat interior architectural woodwork in contact with concrete or masonry.

2.8 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Nailers: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

1. Preservative Treatment: Provide softwood lumber treated by pressure process, AWPA U1; Use Category UC3b.

a. Provide where in contact with concrete or masonry.

B. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.

C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage.

1. Provide metal expansion sleeves or expansion bolts for post-installed anchors.

2. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

D. Installation Adhesive: Product recommended by fabricator for each substrate for secure anchorage.

1. Verify adhesives have a VOC content of 70 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify building concentration of formaldehyde does not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. M, and acetaldehyde concentration does not exceed 9 mcg/cu. m.

2.9 ACCESSORIES

A. Bar drip Tray
1. Basis of Design: Regency Steel Flush Mount Beer Drip Tray
   a. Certifications: NSF Listed, Dishwasher safe
   b. Width: 36 inches
   c. Depth: 5 inches
   d. Height: 3/4 inches
   e. Material: Stainless steel
   f. Mounting Style: Surface-Mounted
   g. Threaded brass drain

B. Bar foot rail
1. Basis of Design: Kegworks 2" OD Bar Foot Rail
   a. 90 degree post mounted to floor and face of bar
      1) 2" OD bar rail bracket
      2) Finish: brushed stainless steel
   b. Tubing
      1) 2" OD bar rail
      2) Wall thickness: 0.05"
      3) Length: as shown on drawings
         a) Use splicing sleeves to join tubes together.
      4) Finish: brushed stainless steel
   c. Flush 90 degree elbow
      1) 2" OD
      2) Finish: Stainless steel
   d. Flush flat end cap
      1) 2" OD bar rail end cap
      2) Finish: brushed stainless steel

C. Concealed Brackets
1. Basis of Design: A&M Hardware, Inc. CFLAT 1.0"
   a. Steel construcion
   b. Load limit range of 1100 lbs to 4900 lbs per pair
   c. Finish: Black powdercoat

D. Island Bar & Brackets
1. Basis of Design: A&M Hardware, Inc. Island Bar and Brackets
a. Steel mounting bracket
b. Steel island bar
1) 2" wide
2) ½" thick
3) Lengths as required.
c. Load limit range of 350 lbs to 3250 lbs.

E. Folding Table Bracket
1. Basis of Design: Hafele Hebgo Table Bracket
a. Heavy Duty
b. Weight Capacity: 1100 lbs per pair
c. Material: Steel; Color: gray primed
d. Size: as required to support countertop

F. Tempered Float Glass for Cabinet Shelves: ASTM C1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3; with exposed edges seamed before tempering, 6 mm thick.

1. Polished Edges

2.10 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
B. Fabricate interior architectural woodwork to dimensions, profiles, and details indicated.

1. Ease edges to radius indicated for the following:

a. Edges of Solid-Wood (Lumber) Members: 1/16 inch (1.5 mm) unless otherwise indicated.
b. Edges of Rails and Similar Members More Than 3/4 Inch (19 mm) Thick: 1/8 inch (3 mm).

C. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site.

1. Disassemble components only as necessary for shipment and installation.
2. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
3. Notify Architect seven days in advance of the dates and times interior architectural woodwork fabrication will be complete.
4. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled.

a. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting.
b. Verify that parts fit as intended, and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.

2.11 SHOP PRIMING

A. Preparations for Finishing: Comply with the Architectural Woodwork Standards for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.

B. Interior Architectural Woodwork for Transparent Finish: Shop-seal concealed surfaces with required pretreatments and first coat of finish as specified in Section 099300 "Staining and Transparent Finishing."

1. Backpriming: Apply one coat of sealer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

2.12 SHOP FINISHING

A. Finish interior architectural woodwork with transparent finish at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.

B. Preparation for Finishing: Comply with Architectural Woodwork Standards, Section 5 for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of interior architectural woodwork. Apply two coats to end-grain surfaces.

C. Transparent Finish:

1. Architectural Woodwork Standards Grade: Premium.
2. Finish System:
   a. 11: Polyurethane, Catalyzed.
3. Staining, Effect, and Sheen: Match Architect's sample.

D. Opaque Finish:

1. Architectural Woodworking Standards Grade: Premium.
2. Finish System:
   a. 4: Latex Acrylic, Water Based.

3. Color: As indicated by manufacturer's designations.
4. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter in accordance with ASTM D523.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition interior architectural woodwork to humidity conditions in installation areas for not less than 72 hours prior to beginning of installation.
B. Before installing interior architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming of concealed surfaces.

3.2 INSTALLATION

A. Grade: Install interior architectural woodwork to comply with same grade as item to be installed.
B. Assemble interior architectural woodwork and complete fabrication at Project site to the extent that it was not completed during shop fabrication.
C. Install interior architectural woodwork level, plumb, true in line, and without distortion.

1. Shim as required with concealed shims.
2. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

D. Scribe and cut interior architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
E. Preservative-Treated Wood: Where cut or drilled in field, treat cut ends and drilled holes in accordance with AWPA M4.
F. Anchor interior architectural woodwork to anchors or blocking built in or directly attached to substrates.

1. Secure with countersunk, concealed fasteners and blind nailing.
2. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with interior architectural woodwork.
3. For shop-finished items, use filler matching finish of items being installed.

G. Standing and Running Trim:

1. Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible.
2. Scarf running joints and stagger in adjacent and related members.
3. Fill gaps, if any, between top of base and wall with plastic wood filler; sand smooth; and finish same as wood base if finished.
4. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches (3 mm in 2400 mm).

3.3 REPAIR

A. Repair damaged and defective interior architectural woodwork, where possible, to eliminate functional and visual defects and to result in interior architectural woodwork being in compliance with requirements of Architectural Woodwork Standards for the specified grade.
B. Where not possible to repair, replace defective woodwork.
C. Shop Finish: Touch up finishing work specified in this Section after installation of interior architectural woodwork.

    1. Fill nail holes with matching filler where exposed.
    2. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

D. Field Finish: See Section 099123 "Interior Painting" and Section 099300 "Staining and Transparent Finishing" for final finishing of installed interior architectural woodwork not indicated to be shop finished.

3.4 CLEANING

A. Clean interior architectural woodwork on exposed and semiexposed surfaces.

END OF SECTION 064023

SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad architectural cabinets.
2. Cabinet hardware and accessories.
3. Miscellaneous materials.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets that are concealed within other construction before cabinet installation.
2. Section 123623.13 "Plastic-Laminate-Clad Countertops."

1.2 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Plastic-laminate-clad architectural cabinets.
2. Cabinet hardware and accessories.
3. Miscellaneous materials.

B. Product Data Submittals: For each product.
C. Sustainable Design Submittals:

1. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
2. Environmental Product Declaration: For each product.

3. For products containing composite wood, provide copies of product labels, chain of custody records or documentation demonstrating compliance with CARB./ATCM formaldehyde regulation.
4. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20.

D. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Show large-scale details.
3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
4. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.

E. Samples for Verification: For the following:

1. Plastic Laminates: 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish required.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.
B. Product Certificates: For each type of product.

1. Composite wood products.
2. Thermally fused laminate panels.
3. High-pressure decorative laminate.
4. Adhesives.

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
B. Installer Qualifications: Manufacturer of products.
C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups of typical architectural cabinets as shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

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

1.8 FIELD CONDITIONS

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

B. Environmental Limitations with Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 43 and 70 percent during the remainder of the construction period.

C. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

   1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.

D. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.

   1. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

B. Architectural Woodwork Standards Grade: Premium.

C. Certified Wood: Certify wood products in accordance with the American Tree Farm System's "AFF Standard," the AF&PA's Sustainable Forestry Initiative, FSC STD-01-001 and FSC STD-40-004, or the standards of the Programme for Endorsement of Forest Certification.
D. Type of Construction: Frameless.
E. Door and Drawer-Front Style: Flush overlay.
F. High-Pressure Decorative Laminate: ISO 4586-3, grades as indicated or if not indicated, as required by quality standard.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. ABET Inc.
b. Formica Corporation.
c. Laminart LLC.
d. Pionite; a Panolam Industries International, Inc. brand.
e. Wilsonart LLC.

G. Exposed Surfaces:

1. Plastic-Laminate Grade:
a. Horizontal Surfaces: Grade HGS
b. Vertical Surfaces: Grade HGS
2. Edges: PVC tape, 0.018-inch (0.460-mm) minimum thickness, matching laminate in color, pattern, and finish.
3. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.

H. Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: Thermally fused laminate panels.
a. Edges of Thermally Fused Laminate Panel Shelves: PVC or polyester edge banding.
b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, ISO 4586-3, grade to match exposed surface.

2. Drawer Sides and Backs: Solid-hardwood lumber.
3. Drawer Bottoms: Hardwood plywood.

I. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, ISO 4583-3, grade to match exposed surface.
J. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

K. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As indicated by laminate manufacturer's designations.

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 8 to 13 percent.

B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
2. Particleboard (Medium Density): ANSI A208.1, Grade M-2.
3. Softwood Plywood: DOC PS 1.
4. Thermally Fused Laminate (TFL) Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of ISO 4586.

2.3 CABINET HARDWARE AND ACCESSORIES

A. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 135 degrees of opening, self-closing.
B. Back-Mounted Pulls: ANSI/BHMA A156.9, B02011.
C. Wire Pulls: Back mounted, solid metal, 5 inches (127 mm) long, 2-1/2 inches (63.5 mm) deep, and 5/16 inch (8 mm) in diameter.
D. Catches: Magnetic catches, ANSI/BHMA A156.9, B03141.
E. Adjustable Shelf Standards and Supports: ANSI/BHMA A156.9, B04071; with shelf rests, B04081.
F. Shelf Rests: ANSI/BHMA A156.9, B04013; two-pin plastic with shelf hold-down clip.
G. Drawer Slides: ANSI/BHMA A156.9.

1. Standard Duty (Grade 1 and Grade 2): Side mount and extending under bottom edge of drawer.

a. Type: Full extension.
b. Material: Epoxy-coated polymer or Zinc-plated ball bearing slides.
c. Motion Feature: Soft close dampener.

2. General-purpose drawers more than 3 inches (75 mm) high, but not more than 6 inches (150 mm) high and not more than 24 inches (600 mm) wide, provide 75 lb (34 kg) load capacity.
3. File drawers more than 6 inches (150 mm) high or more than 24 inches (600 mm) wide, provide 100 lb (45 kg) load capacity.

H. Door Locks: ANSI/BHMA A156.11, E07121.
I. Drawer Locks: ANSI/BHMA A156.11, E07041.
J. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.
K. Grommets for Cable Passage: as required for kitchen equipment OD, molded-plastic grommets and matching plastic caps with slot for wire passage.

1. Color: As selected by architect.

L. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated.
1. Satin Chromium Plated: ANSI/BHMA 652 for steel base.
2. Satin Stainless Steel: ANSI/BHMA 630.

M. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.4 MISCELLANEOUS MATERIALS

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

1. Adhesive for Bonding Edges: Hot-melt adhesive.
2. VOC Limits: comply with VOC limits indicated in Section 018113.54.

2.5 FABRICATION

A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.
B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for

shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Trial fit assemblies at manufacturer's shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.2 INSTALLATION

A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.
B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.
C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.
D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm) using concealed shims.

1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches (400 mm) o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.
B. Clean, lubricate, and adjust hardware.
C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION 064116

SECTION 064216 - FLUSH WOOD PANELING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Flush wood paneling (wood-veneer wall surfacing).
2. Installation materials.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing paneling that is concealed within other construction before paneling installation.

1.2 COORDINATION

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

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Sustainable Design Submittals:

1. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
2. Product Data: For installation adhesives, indicating VOC content.
3. Laboratory Test Reports: For installation adhesives, indicating compliance with requirements for low-emitting materials.
4. Environmental Product Declaration: For each product.
5. For products containing composite wood, provide copies of product labels, chain of custody records or documentation demonstrating compliance with CARB./ATCM formaldehyde regulation.
6. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20.

C. Shop Drawings: For flush wood paneling.

1. Include plans, elevations, sections, and attachment details.
2. Show details full size.
3. Show locations and sizes of furring and blocking, including concealed blocking specified in other Sections.
4. For paneling produced from premanufactured sets, show finished panel sizes, set numbers, sequence numbers within sets, and method of cutting panels to produce indicated sizes.
5. For paneling veneered in fabrication shop, show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

D. Samples: For each exposed product and for each color and finish specified, in manufacturer's or fabricator's standard size.
E. Samples for Initial Selection: For each type of exposed finish.
F. Samples for Verification: For the following:

1. Lumber for Transparent Finish: Not less than 5 inches (125 mm) wide by 12 inches (300 mm) long, for each species and cut, finished on one side and one edge.
2. Veneer Leaves: Representative of and selected from flitches to be used for transparent-finished paneling.
3. Veneer-Faced Panel Products for Transparent Finish: 8 by 10 inches (200 by 250 mm), for each species and cut. Include at least one face-veneer seam and finish as specified.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.
B. Product Certificates: For each type of product.
C. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
B. Shop Certification: AWI's Quality Certification Program accredited participant.
C. Installer Qualifications: Fabricator of products.

1.7 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups of typical paneling as shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

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

1.9 FIELD CONDITIONS

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

B. Environmental Limitations with Humidity Control: Do not deliver or install paneling until building is enclosed, wet-work is complete, and HVAC system is operating and will maintain temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 17 and 50 percent during the remainder of the construction period.

C. Field Measurements: Where paneling is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support paneling by field measurements before being enclosed/concealed by construction and indicate measurements on Shop Drawings.

D. Established Dimensions: Where paneling is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of paneling, wood trim, and wood frames.

2.2 PANELING, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of flush wood paneling (wood-veneer wall surfacing) indicated for construction, finishes, installation, and other requirements.

2.3 FLUSH WOOD PANELING (WOOD-VENEER WALL SURFACING)

A. Grade: Custom.
B. Certified Wood: Certify wood products in accordance with the American Tree Farm System's "AFF Standard," the AF&PA's Sustainable Forestry Initiative, FSC STD-01-001 and FSC STD-40-004, or the standards of the Programme for Endorsement of Forest Certification.
C. Wood Species and Cut: Select white maple, plain sliced.
D. Veneer Matching Method:

1. Adjacent Veneer Leaves: Slip match.
2. Within Panel Face: Running match.

E. Panel-Matching Method: No matching is required between adjacent panels. Select and arrange panels for similarity of grain pattern and color between adjacent panels.
F. Panel Core Construction: Hardwood veneer-core plywood or MDF.

1. Thickness: 3/4 inch (19 mm).

G. Exposed Panel Edges: Inset solid-wood or wood-veneer matching faces .
H. Panel Reveals: hardwood stained to match panel.
I. Assemble panels by gluing and concealed fastening.

2.4 MATERIALS

A. Materials, General: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.
B. Wood Moisture Content: 8 to 13 percent.
C. Composite Wood Products: Comply with California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or provide products made with no added formaldehyde.
1. MDF: ANSI A208.2, Grade 130.
2. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

2.5 INSTALLATION MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls.

C. Installation Adhesive: Product recommended by panel fabricator for each substrate for secure anchorage.

1. Verify adhesives have a VOC content of 70 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify building concentration of formaldehyde does not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. M, and acetaldehyde concentration does not exceed 9 mcg/cu. m.

2.6 FABRICATION

A. Complete fabrication, including assembly, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

B. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

2.7 SHOP FINISHING

A. General: Finish paneling at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing paneling, as applicable to each unit of work.

1. Backpriming: Apply two coats of sealer or primer, compatible with finish coats, to concealed surfaces of paneling.

C. Transparent Finish:

1. Grade: Same as item to be finished.
2. Finish: System - 11, catalyzed polyurethane.

3. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
4. Staining: Match approved sample for color.
5. Filled Finish for Open-Grain Woods: After staining, apply wash-coat sealer and allow to dry. Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
6. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D523.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION

A. Grade: Install paneling to comply with quality standard grade of paneling to be installed.
B. Install paneling level, plumb, true in line, and without distortion. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm). Install with no more than 1/16 inch in 96-inch (1.6 mm in 2400-mm) vertical cup or bow and 1/8 inch in 96-inch (3 mm in 2400-mm) horizontal variation from a true plane.

1. For flush paneling with revealed joints, install with variations in reveal width, alignment of top and bottom edges, and flushness between adjacent panels not exceeding 1/32 inch (0.8 mm).

C. Complete finishing work specified in this Section to extent not completed at shop or before installation of paneling. Fill nail holes with matching filler where exposed.

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

3.3 ADJUSTING AND CLEANING

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

END OF SECTION 064216

SECTION 066400 - PLASTIC PANELING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic sheet paneling.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Sustainable Design Submittals:
1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
3. Product Data: For sealants, indicating VOC content.
4. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
5. Environmental Product Declaration: For each product.
6. VOC Content for each product.
7. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20.

C. Samples: For plastic paneling and trim accessories, in manufacturer's standard sizes.

1.3 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain plastic paneling and trim accessories from single manufacturer.

2.2 PLASTIC SHEET PANELING

A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D5319. Panels are to be USDA accepted for incidental food contact.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Crane Composites, Inc.
   b. Marlite, Inc.
   c. Parkland Plastics.

2. Surface-Burning Characteristics: As follows when tested by a qualified testing agency in accordance with ASTM E84. Identify products with appropriate markings of applicable testing agency.

   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 450 or less.

3. Nominal Thickness: Not less than 0.09 inch (2.3 mm).
4. Surface Finish: Molded pebble texture.
5. Color: As selected by Architect from manufacturer's full range.

B. Unreinforced PVC Paneling: Solid polyvinyl chloride panels. Panels are to be USDA accepted for incidental food contact.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. Acrovyn.
   b. Inpro.
2. Surface-Burning Characteristics: As follows when tested by a qualified testing agency in accordance with ASTM E84. Identify products with appropriate markings of applicable testing agency.

   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 450 or less.

3. Nominal Thickness: Not less than 0.03 inch (0.75 mm).
4. Surface Finish: Molded pebble texture.
5. Color: As selected by Architect from manufacturer's full range.

2.3 ACCESSORIES

A. Trim Accessories: Manufacturer's standard vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.

1. Color: As selected by Architect from manufacturer's full range.

B. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer.
C. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.
D. Adhesive: As recommended by plastic paneling manufacturer.

1. Verify adhesives have a VOC content of 50 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify building concentration of formaldehyde does not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. M, and acetaldehyde concentration does not exceed 9 mcg/cu. m.

E. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 079200 "Joint Sealants."

1. Verify sealant has a VOC content of 250 g/L or less.
2. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify building concentration of formaldehyde does not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and acetaldehyde concentration does not exceed 9 mcg/cu. m.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

A. Remove wallpaper, vinyl wall covering, loose or soluble paint, and other materials that might interfere with adhesive bond.
B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.
C. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.

D. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
E. Lay out paneling before installing. Locate panel joints so that trimmed panels at corners are not less than 12 inches (300 mm) wide.

1. Mark plumb lines on substrate at locations for accurate installation.
2. Locate trim accessories to allow clearance at panel edges according to manufacturer's written instructions.

3.3 INSTALLATION

A. Install plastic paneling according to manufacturer's written instructions.
B. Install panels in a full spread of adhesive.
C. Install trim accessories with adhesive and nails or staples. Do not fasten through panels.
D. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.
E. Maintain uniform space between panels and wall fixtures. Fill space with sealant.
F. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION 066400

SECTION 071326 - SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Bonded HPDE or polyethylene sheet waterproofing
2. Blindside sheet waterproofing.
3. Protection course.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.
2. Review transitions within waterproofing system and between waterproofing and adjacent air barrier.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
2. Include manufacturer's written installation instructions for evaluating, preparing, and treating substrate.

B. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, expansion joints, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, air barrier, and other termination conditions.

1. Include setting drawings that indicate layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.

C. Samples: For each product, including the following materials:

1. 8-by-8-inch (200-by-200-mm) square of waterproofing and flashing sheet.
2. 4-by-4-inch (100-by-100-mm) square of drainage panel.

D. Sustainable Design Submittals:

1. Product data: For waterproofing providing information for testing in compliance with ASHRAE 160-2009.
2. Environmental Product Declaration: For each product.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For Installer.
B. Sample warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer. Do not apply waterproofing to frozen, damp, or wet substrates.

1. Do not apply waterproofing when snow, rain, fog, or mist is present.

B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.7 COORDINATION

A. Coordinate requirements for concrete formwork to provide suitable substrate for waterproofing and to minimize penetrations through waterproofing.

1.8 WARRANTY

A. Manufacturer's Warranty:

1. Waterproofing Warranty: Manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.

a. Warranty Period: Five years from date of Substantial Completion.

B. Installer's Special Warranty: Specified form,signed by Installer, covering Work of this Section, for warranty period of two years.

1. Warranty includes removing and reinstalling protection board, drainage panels, insulation,.

PART 2 - PRODUCTS

2.1 BONDED HDPE OR POLYETHYLENE SHEET WATERPROOFING

A. Products: Subject to compliance with requirements, provide one of the following:
1. Basis-of-Design Product for Vertical Applications: Subject to compliance with requirements, provide **Grace, W. R., & Co.; Bituthene 3000**, or comparable product by one of the following:
a. Cetco
b. Tremco
2. Basis-of-Design Product for Horizontal Applications: Subject to compliance with requirements, provide **Grace, W. R., & Co.; Preprufe 300R**, or comparable product by one of the following:
a. Carlisle
b. Cetco

B. Bonded HDPE Sheet for Vertical Applications: Uniform, flexible, multilayered-composite sheet membrane consisting of either a HDPE film coated with a pressure-sensitive adhesive and protective release liner, total 1.5 mm thickness:
1. Tensile Strength, Film: 4 N/mm minimum; ASTM D 412.
2. Low-Temperature Flexibility: Pass at minus 10 deg F (minus 23 deg C); ASTM C 836.
3. Peel Adhesion to Concrete: 5 lbf/in. (875 N/m) minimum; ASTM D 903, modified.
4. Lap Adhesion: 683 N/m minimum; ASTM D 1876, modified.
5. Hydrostatic-Head Resistance: 60m; ASTM D 5385, modified.
6. Tear Resistance: 23 N/mm; ASTM D 624.
7. Puncture Resistance: 200N or greater; ASTM E 154.
8. Water Vapor Permeance: 1.9 na/Pa.m2.S maximum; ASTM E 96/E 96M, Water Method.

C. Bonded HDPE or Polyethylene Sheet for Horizontal Applications: Uniform, flexible, multilayered-composite sheet membrane consisting of either an HDPE film coated with pressure-sensitive adhesive and protective release liner, total 46-mil (1.2-mm) thickness, or a cross-laminated film of low- and medium-density polyethylene, coated with a modified asphalt layer and a nonwoven geotextile-fabric final layer, total 95-mil (2.4-mm) thickness; with the following physical properties:
1. Tensile Strength, Film: 2000 psi (13.8 MPa) minimum; ASTM D 412.
2. Low-Temperature Flexibility: Pass at minus 10 deg F (minus 23 deg C); ASTM D 1970.
3. Peel Adhesion to Concrete: 5 lbf/in. (875 N/m) minimum; ASTM D 903, modified.
4. Lap Adhesion: 2.5 lbf/in. (440 N/m) minimum; ASTM D 1876, modified.
5. Hydrostatic-Head Resistance: 231 feet (70 m); ASTM D 5385, modified.
6. Puncture Resistance: 200 lbf (890 N) minimum; ASTM E 154.
7. Water Vapor Permeance: 0.01 perms (0.6 ng/Pa x s x sq. m) maximum; ASTM E 96/E 96M, Water Method.
8. Water Absorption: 0.5 percent maximum; ASTM D 570.

D. Mastic, Adhesives, and Detail Tape: Liquid mastic and adhesives, and adhesive tapes recommended and required by waterproofing manufacturer.
   1. Bituthene Liquid Membrane: Two-component 100% solids trowel grade asphalt modified urethane.
   2. Bituthene Surface Conditioner: Latex/water based primer specifically formulated to provide adhesion of Bituthene Waterproofing Membranes.
   3. Bituthene Elastomeric Mastic: Rubberized asphalt base mastic.
   4. Bitustik Tape: Double sided synthetic adhesive tape.

2.2 AUXILIARY MATERIALS

A. Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.

   1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid waterborne primer recommended for substrate by sheet waterproofing material manufacturer.
C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet waterproofing material manufacturer.
D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.
E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.
F. Metal Termination Bars: Aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm), predrilled at 9-inch (229-mm) centers.
G. Protection Course, Asphaltic: ASTM D6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:

   1. Thickness: Nominal 1/4 inch (6 mm).
   2. Adhesive: Rubber-based solvent type recommended by waterproofing manufacturer for protection course type.

2.3 MOLDED-SHEET DRAINAGE PANELS

A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panel consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 (0.21-mm) sieve laminated to one side of the core and a polymeric film bonded to the other side; and with a vertical flow rate of 9 to 15 gpm per ft. (112 to 188 L/min. per m).

1. Basis-of-Design Product: Subject to compliance with requirements, provide Grace, W. R., & Co.; Hydroduct 220, or comparable product by one of the following:
   a. American Hydrotech, Inc.; Hydrodrain 400.
   b. Carlisle Coatings & Waterproofing Inc.; CCW MiraDRAIN 6200

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of waterproofing.

1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D4263.
3. Verify that compacted subgrade is dry, smooth, sound, and ready to receive waterproofing sheet.

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

3.2 PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
D. Remove fins, ridges, mortar, and other projections.
E. Fill form tie holes, honeycomb, aggregate pockets, holes, and other voids.
F. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D4258.

1. Install sheet strips of width according to manufacturer's written instructions and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch (1.6 mm).

G. Bridge and cover isolation joints, expansion joints, and discontinuous deck-to-wall and deck-to-deck joints with overlapping sheet strips of widths according to manufacturer's written instructions.

1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.

H. Corners: Prepare, prime, and treat inside and outside corners in accordance with manufacturer's instructions.

1. Install membrane strips centered over vertical inside corners. Install 3/4-inch (19-mm) fillets of liquid membrane on horizontal inside corners and as follows:

a. At footing-to-wall intersections, extend liquid membrane in each direction from corner or install membrane strip centered over corner.

I. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions.

3.3 BONDED HDPE WATERPROOFING APPLICATION

A. Install bonded HDPE or polyethylene sheets according to manufacturer's written instructions.
1. Place the membrane HDPE film side to the substrate with the clear plastic release liner facing towards the concrete pour. End laps should be staggered to avoid a build-up of layers.
2. Leave the plastic release liner in position until overlap procedure is completed.
3. Accurately position succeeding sheets to overlap the previous sheet 3 in. (75 mm) along the marked selvedge. Ensure the underside of the succeeding sheet is clean, dry and free from contamination before attempting to overlap.
4. Peel back the plastic release liner from between the overlaps as the two layers are bonded together. Ensure a continuous bond is achieved without creases and roll firmly with a heavy roller.
5. Completely remove the plastic liner to expose the protective coating. Any initial tack will quickly disappear.

B. Seal penetrations through sheet waterproofing to provide watertight seal with detail tape patches or wraps and a liquid-membrane troweling.

C. Install sheet-waterproofing and auxiliary materials to produce a continuous watertight tie into adjacent waterproofing.

D. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Tape perimeter of damaged or nonconforming area extending 6 inches (150 mm) beyond repaired areas in all directions. Apply a patch of sheet waterproofing and firmly secure with detail tape.

3.4 SELF ADHERERED POLYETHYLENE WATERPROOFING APPLICATION

A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions.

B. Apply primer to substrates at required rate and allow to dry. (B2 LVC Primer) Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.

C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch- (64-mm-) minimum lap widths and end laps. Overlap and seal seams and stagger end laps to ensure watertight installation.

D. All laps, including side and end laps are to be sealed with a minimum 1 inch troweled application of Liquid Membrane or Mastic.

E. Apply continuous sheets over sheet strips bridging substrate cracks, construction, and contraction joints.

F. Seal exposed edges of sheets at terminations not concealed by metal counterflashings or ending in reglets with mastic.

G. Installation of Termination Bar at top of wall terminations. Termination bar is to be covered with Liquid membrane or Mastic.

H. Corners: Seal lapped terminations and cut edges of sheet waterproofing at inside and outside corners with detail tape.

1. Corner Forming: Outside corners must be free of sharp edges. Inside corners shall receive a fillet formed with Liquid Membrane, latex modified cement mortar equal to Daraweld C made by Grace mixed with cement mortar or epoxy mortar. Do not use fiber or wood cants.

I. Seal penetrations through sheet waterproofing to provide watertight seal with detail tape patches or wraps and a liquid-membrane troweling.

J. Seam Reinforcement:

1. Provide a 6-inch strip of modified bituminous sheet membrane (Bituthene) centered behind all laps.
2. At locations where a selvage edge is not present and at end laps, lap sheets 6 inches, apply a 1/8-inch thick by 6-inch wide application of liquid membrane between sheets, to provide a 6-inch wide seal.
3. Integration of old onto new pre-applied sheet membrane. Integration of Sheet Membrane onto Sheet Membrane that has been installed in excess of 30 days prior
   a. Lap sheets 12-inch, apply a 1/8-inch thick by 6-inch wide application of fluid membrane between sheets, to provide a 12-inch wide seal at this location.
   b. Install Waterproofing Tape centered at edge of lap and roll firmly into place with an approved roller.
   c. Install additional Waterproofing Tape to cover white film that has been installed over 30 days prior.
4. Repair of pre-applied sheet membrane
   a. Scratch on white coating exposing underlying black surfing of Sheet Membrane: Install Waterproofing Tape at areas where the white coating of the membrane is damaged, including boot scuff marks and abrasions by rebar.
   b. Damage or Puncture of Sheet Membrane: Install Patch of short Membrane set in Liquid Membrane. Patch must extend 3 inches minimum in every direction around extent

of damaged area. Install Waterproofing Tape centered over the edge of the patch. If the damaged area does not have 6 inches of sound material around it, inject Liquid Membrane into puncture until Liquid Membrane backs out, and proceed with patch as space allows.

K. Install sheet-waterproofing and auxiliary materials to produce a continuous watertight tie into adjacent waterproofing.

L. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Tape perimeter of damaged or nonconforming area extending 6 inches (150 mm) beyond repaired areas in all directions. Apply a patch of sheet waterproofing and firmly secure with detail tape.

M. Install protection course with butted joints over waterproofing membrane immediately.

N. Correct deficiencies in or remove sheet waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

3.5 INSTALLATION OF MOLDED-SHEET DRAINAGE PANELS

A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesive or another method that does not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

1. For vertical applications, install board insulation before installing drainage panels.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage asite representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components; and to furnish daily reports to Architect.

C. Flood Testing: Flood test each deck area for leaks, in accordance with recommendations in ASTM D5957, after completing waterproofing but before placing overlying construction. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

1. Flood to an average depth of 2-1/2 inches (64 mm) with a minimum depth of 1 inch (25 mm) and a maximum depth of 4 inches (100 mm). Maintain 2 inches (51 mm) of clearance from top of sheet flashings.
2. Flood each area for 24 hours.
3. Testing agency will observe flood testing and examine underside of decks and terminations for evidence of leaks during flood testing.
4. After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing installation is watertight.

a. Cost of retesting is Contractor's responsibility.

5. Testing agency will prepare survey report indicating locations of initial leaks, if any, and final survey report.

D. Waterproofing will be considered defective if it does not pass tests and inspections.

3.7 PROTECTION, REPAIR, AND CLEANING

A. Do not permit foot or vehicular traffic on unprotected membrane.
B. Protect waterproofing from damage and wear during remainder of construction period.
C. Protect installed insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.
E. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 071326

SECTION 071900 - WATER REPELLENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Penetrating water repellents.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Penetrating water repellents.

B. Product Data Submittals:

1. Include manufacturer's printed statement of VOC content.
2. Include manufacturer's standard colors.
3. Include manufacturer's recommended number of coats for each type of substrate and spreading rate for each separate coat.

C. Samples: For each type and color of water repellent and substrate indicated, 12 by 12 inches (300 by 300 mm) in size, with specified water-repellent treatment applied to half of each Sample.

D. Sustainable Design Submittals:

1. "Sustainable Design Requirements – Green Globes 2021" to validate the credits claimed to achieve Green Globes goals.
   a. Cradle-to-Gate Product Life Cycle certifications, where available.
   b. Recycled Content:, pre- and post-consumer content, where available.
   c. Sealants: Indicate VOC content.
   d. Environmental Product Declaration: For each product.
2. Laboratory Test Reports: For coatings, indicating compliance with requirements for low-emitting materials.
3. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Applicator.
B. Product Certificates: For each type of water repellent.
C. Field quality-control reports.
D. Sample Warranty: For special warranty.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: An employer of workers trained and approved by manufacturer.
B. Mockups: Prepare mockups of each required water repellent on each type of substrate required to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Locate mockups in locations that enable viewing under same conditions as the completed Work.

   a. Size: 10 sq. ft. (9.3 sq. m) each.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 FIELD CONDITIONS

A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied in accordance with manufacturers' written instructions and warranty requirements:

1. Concrete surfaces and mortar have cured for not less than 28 days.
2. Building has been closed in for not less than 30 days before treating wall assemblies.
3. Ambient temperature is above 40 deg F (4.4 deg C) and below 100 deg F (37.8 deg C) and will remain so for 24 hours.
4. Substrate is not frozen and substrate-surface temperature is above 40 deg F (4.4 deg C) and below 100 deg F (37.8 deg C).
5. Rain or snow is not predicted within 24 hours.
6. Not less than seven days have passed since surfaces were last wet.
7. Windy conditions do not exist that might cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer and Applicator agree(s) to repair or replace materials that fail to maintain water repellency specified in "Performance Requirements" Article within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Performance: Water repellents must meet the following performance requirements as determined bytesting on manufacturer's standard substrates representing those indicated for this Project.
B. Water Absorption: Minimum 90 percent reduction of water absorption after 24 hours for treated compared to untreated specimens when tested according to the following:

1. Cast-in-Place Concrete: ASTM C642.

C. Water Penetration and Leakage through Masonry: Minimum 90 percent reduction in leakage rate of treated compared to untreated specimens, in accordance with ASTM E514/E514M.
D. Durability: Maximum 5 percent loss of water-repellent performance after 2500 hours of weathering in accordance with ASTM G154 compared to water-repellent-treated specimens before weathering.
E. Chloride-Ion Intrusion in Concrete: NCHRP Report 244, Series II tests.

1. Reduction of Water Absorption: 80 percent.
2. Reduction in Chloride Content: 80 percent.

2.2 PENETRATING WATER REPELLENTS

A. Penetrating Low-VOC Silane Water Repellent: Clear, containing 100 percent or more active content of [**modified**]silane; with alcohol, mineral spirits, water, or other proprietary solvent carrier; and with 400 g/L or less of VOCs.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Master Builders Solutions; brand of MBCC Group; **MasterProtect H 1000** or a comparable product by one of the following:

a. Advanced Chemical Technologies, Inc.
b. ChemMasters, Inc.
c. Chemical Products Industries, Inc.
d. Concrete Sealers USA.
e. Dayton Superior Corporation.

f. PROSOCO, Inc.
g. Tnemec Company, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.

1. Verify that surfaces are clean and dry in accordance with water-repellent manufacturer's requirements. Check moisture content in three representative locations by method recommended by manufacturer.
2. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
3. Verify that required repairs are complete, cured, and dry before applying water repellent.

B. Test pH level in accordance with water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. New Construction and Repairs: Allow concrete and other cementitious materials to age before application of water repellent, in accordance with repellent manufacturer's written instructions.
B. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product in accordance with water-repellent manufacturer's written instructions and as follows:

1. Cast-in-Place Concrete: Remove oil, curing compounds, laitance, and other substances that inhibit penetration or performance of water repellents in accordance with ASTM E1857.

C. Protect adjoining work, including mortar and sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live vegetation.
D. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.

1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

3.3 APPLICATION OF WATER REPELLENTS

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.

B. Apply coating of water repellent on surfaces to be treated using 15 psi- (103 kPa-) pressure spray with a fan-type spray nozzle, roller or brush to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.

C. Apply a second saturation coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.4 FIELD QUALITY CONTROL

A. Testing of Water-Repellent Material: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when water repellent is being applied:

1. Owner will engage the services of a qualified testing agency to sample water-repellent material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will perform tests for compliance of water-repellent material with product requirements.
3. Owner may direct Contractor to stop applying water repellents if test results show material being used does not comply with product requirements. Contractor to remove noncomplying material from Project site, pay for testing, and correct deficiency of surfaces treated with rejected materials, as approved by Architect..

B. Coverage Test: In the presence of Architect, hose down a dry, repellent-treated surface to verify complete and uniform product application. A change in surface color will indicate incomplete application.

1. Notify Architect seven days in advance of the dates and times when surfaces will be tested.
2. Reapply water repellent until coverage test indicates complete coverage.

3.5 CLEANING

A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application, as approved by Architect.

B. Comply with manufacturer's written cleaning instructions.

END OF SECTION 071900

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Polyisocyanurate foam-plastic board insulation.
2. Glass-fiber blanket insulation.
3. Mineral-wool board insulation.
4. Spray-applied cellulosic insulation.

B. Related Requirements:
1. Section 072119 "Foamed-in-Place Insulation" for spray-applied polyurethane foam insulation.
2. Section 075216 "Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing" for insulation specified as part of roofing construction.
3. Section 092900 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

1.2 ACTION SUBMITTALS

A. Product Data:
1. Polyisocyanurate foam-plastic board insulation.
2. Glass-fiber blanket insulation.
3. Mineral-wool board insulation.
4. Spray-applied cellulosic insulation.

B. Sustainable Design Submittals:
1. Environmental Product Declaration: For each product.
2. Third-Party Certifications: For each product.
3. Third-Party Certified Life Cycle Assessment: For each product.
4. Product Data: For adhesives, indicating VOC content.
5. VOC Content for each product.
6. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
7. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20.

1.3 INFORMATIONAL SUBMITTALS

A. Installer's Certification: Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope.

1. For blown-in or sprayed fiberglass and cellulosic-fiber loose-fill insulation, indicate initial installed thickness, settled thickness, settled R-value, installed density, coverage area, and number of bags installed.
2. Sign, date, and post the certification in a conspicuous location on Project site.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
C. Research Reports: For foam-plastic insulation, from ICC-ES.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes less than 25 and 450 when tested in accordance with ASTM E84.
B. Fire-Resistance Ratings: Comply with ASTM E119 or UL 263; 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 listings of another qualified testing agency.

C. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
D. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.
E. Thermal-Resistance Value (R-Value): R-value as indicated on Drawings in accordance with ASTM C518.
F. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than & 50 percent.

1. Verify adhesives have a VOC content of 70 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental

Chambers." Verify building concentration of formaldehyde does not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and acetaldehyde concentration does not exceed 9 mcg/cu. m.

2.2 POLYISOCYANURATE FOAM-PLASTIC BOARD INSULATION

A. Polyisocyanurate Board Insulation, Foil Faced: ASTM C1289, foil faced, Type I, Class 2.

1. Basis-of-Design Product: Subject to compliance with requirements, provide DuPont de Nemours, Inc.; Thermax White ci or a comparable product by one of the following:

   a. Hunter Panels; a Carlisle company.
   b. Rmax, A Business Unit of Sika Corporation.

2.3 GLASS-FIBER BLANKET INSULATION

A. Glass-Fiber Blanket Insulation, Unfaced: ASTM C665, Type I; passing ASTM E136 for combustion characteristics.

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. CertainTeed; SAINT-GOBAIN.
   b. Johns Manville; a Berkshire Hathaway company.
   c. Knauf Insulation.
   d. Owens Corning.

2.4 MINERAL-WOOL BOARD INSULATION

A. Mineral-Wool Board Insulation, Type IVB: ASTM C612, Type IVB; unfaced.

1. Nominal Density: 8 lb/cu. ft. (128 kg/cu. m).

2.5 SPRAY-APPLIED CELLULOSIC INSULATION

A. Self-Supported, Spray-Applied Cellulosic Insulation: ASTM C1149, Type II (materials containing a dry adhesive activated by water during installation; intended only for enclosed or covered applications), chemically treated for flame-resistance, processing, and handling characteristics.

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. Greenfiber, LLC.
   b. Hamilton Manufacturing, Inc. (HMI).
   c. International Cellulose Corp.

2.6 INSULATION FASTENERS

A. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

2.7 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.
2. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.

B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.
B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
C. Install insulation with manufacturer's R-value label exposed after insulation is installed.
D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face and as recommended by manufacturer.

1. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.
2. Press units firmly against inside substrates.
3. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

3.4 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
1. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

C. Spray-Applied Cellulosic Insulation: Apply spray-applied insulation according to manufacturer's written instructions.

1. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked.
2. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.

3.5 PROTECTION

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

END OF SECTION 072100

SECTION 072119 - FOAMED-IN-PLACE INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Closed-cell spray polyurethane foam insulation.
2. Accessories.

B. Related Requirements:

1. Section 072100 "Thermal Insulation" for foam-plastic board insulation.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Closed-cell spray polyurethane foam insulation.
2. Accessories.

B. Sustainable Design Submittals:

1. Environmental Product Declaration
2. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by qualified testing agency.
B. Research Reports: For spray-applied polyurethane foam-plastic insulation, from ICC-ES showing compliance with.
C. Field quality-control reports.
D. Qualification Statements: For Installer.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 CLOSED-CELL SPRAY POLYURETHANE FOAM INSULATION

A. Closed-Cell Spray Polyurethane Foam: ASTM C1029, Type II, minimum density of 1.5 lb/cu. ft. (24 kg/cu. m) and minimum aged R-value at 1-inch (25.4-mm) thickness of 6.2 deg F x h x sq. ft./Btu at 75 deg F (43 K x sq. m/W at 24 deg C).

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. Carlisle Spray Foam Insulation.
    b. Henry Company; a Carlisle company.
    c. Huntsman Building Solutions.
    d. Master Builders Solutions; brand of MBCC Group.
    e. Thermoseal USA.

2. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

    a. Flame-Spread Index: 25 or less.
    b. Smoke-Developed Index: 450 or less.

3. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.2 ACCESSORIES

A. Primer: Material recommended by insulation manufacturer where required for adhesion of insulation to substrates.

B. Thermal Barrier: Material barrier intended to prevent flame-source access to foam and delay temperature-rise of foam during a fire event.

1. Materials tested in accordance with and complying with acceptance criteria of both the Temperature Transmission Fire Test and the Integrity Fire Test of NFPA 275.
2. Thermal Barrier Coating: Fire-protective intumescent coating formulated for application over polyurethane foam plastics, compatible with insulation, and passes NFPA 275 testing as part of an approved assembly.
3. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

    a. Flame-Spread Index: 25 or less.
    b. Smoke-Developed Index: 50 or less.

4. Topcoat: 8- to 12-mil- (2- to 3-mm-) thick, heavy-duty protective coating recommended in writing by intumescent thermal barrier manufacturer as compatible with substrate materials.

C. Ignition Barrier: Material providing a 15-minute minimum fire-ignition barrier.
1. Ignition Barrier Coating: Fire-protective coating formulated for application over polyurethane foam plastics, compatible with insulation, and in compliance with ICC-ES AC377, Appendix X.
2. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 50 or less.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that substrates are clean, dry, and free of substances that are harmful to insulation.
B. Priming: Prime substrates where recommended by insulation manufacturer. Apply primer to comply with insulation manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.

3.2 INSTALLATION

A. Comply with insulation manufacturer's written instructions applicable to products and applications.
B. Spray insulation to envelop entire area to be insulated and fill voids.
C. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.
D. Cavity Walls: Install into cavities to thickness indicated on Drawings.
E. Miscellaneous Voids: Apply according to manufacturer's written instructions.
F. Install ignition barrier material.

1. Do not cover insulation prior to any required spray foam insulation inspections.

G. Apply barrier coatings in accordance with manufacturer's written instructions and to comply with requirements for listing and labeling for fire-propagation characteristics and surface-burning characteristics specified.

1. Use equipment and techniques best suited for substrate and type of material applied as recommended by coating manufacturer.
2. Apply coatings to prepared surfaces as soon as practical after preparation and before subsequent surface soiling or deterioration.
3. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Produce sharp lines and color breaks.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect spray foam insulation installation, including accessories. Report results in writing.

3.4 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

END OF SECTION 072119

SECTION 072414 – DIRECT APPLIED EXTERIOR FINISH SYSTEM (DEFS)

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. DEFS-clad barrier-wall and soffit assemblies that are field applied over substrate.

B. Related Requirements:
1. Section 079200 "Joint Sealants" for sealing joints in DEFS with elastomeric joint sealants and for perimeter joints between DEFS and other materials.

1.3 DEFINITIONS

A. Definitions in ASTM E2110 apply to Work of this Section.
B. DEFS: Direct-Applied Exterior finish system(s).
C. IBC: International Building Code.

1.4 ACTION SUBMITTALS

A. Product Data: For each DEFS component, trim, and accessory.
B. Samples: For each exposed product and for each color and texture specified, 8 inches (200 mm) square in size.
C. Samples for Initial Selection: For each type of finish-coat color and texture indicated.

1. Include similar Samples of exposed accessories involving color selection.

D. Samples for Verification: 24-inch- (600-mm-) square panels for each type of finish-coat color and texture indicated, prepared using same tools and techniques intended for actual work.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Manufacturer Certificates: Signed by DEFS manufacturer, certifying the following:

1. DEFS substrate is acceptable to DEFS manufacturer.
2. Accessory products installed with DEFS, including joint sealants, flashing, water-resistant barriers and trim, whether or not furnished by DEFS manufacturer and whether or not specified in this Section, are acceptable to DEFS manufacturer.

C. Product Test Reports: For each DEFS assembly and component, for tests performed by a qualified testing agency.
D. Field quality-control reports.
E. Sample Warranty: For manufacturer's special warranty.
F. Sustainable Design Submittals:

1. Environmental Product Declaration: For each product.
2. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For DEFS to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An installer who is certified in writing by DEFS manufacturer as qualified to install manufacturer's system using trained workers.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original, unopened packages with manufacturers' labels intact and clearly identifying products.
B. Store materials inside and under cover; keep them dry and protected from weather, direct sunlight, surface contamination, aging, corrosion, damaging temperatures, construction traffic, and other causes.

1.9 FIELD CONDITIONS

A. Weather Limitations: Maintain ambient temperatures above 40 deg F (4.4 deg C) for a minimum of 24 hours before, during, and after adhesives or coatings are applied. Do not apply DEFS adhesives or coatings during rainfall. Proceed with installation only when existing and forecasted weather conditions and ambient outdoor air, humidity, and substrate temperatures permit DEFS to be applied, dried, and cured according to manufacturers' written instructions and warranty requirements.

1.10 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace DEFS that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Bond integrity and weathertightness.
b. Deterioration of DEFS finishes and other DEFS materials beyond normal weathering.

2. Warranty coverage includes the following DEFS components:

a. DEFS finish, including base coats, finish coats, and reinforcing mesh.
b. DEFS accessories, including trim components and flashing.

3. Warranty Period: Five years from date of Substantial Completion.

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. Dryvit Systems, Inc.
2. Senergy; Master Builders Solutions.
3. Sto Corp.

B. Source Limitations: Obtain DEFS from single source from single DEFS manufacturer and from sources approved by DEFS manufacturer as tested and compatible with DEFS components.

2.2 PERFORMANCE REQUIREMENTS

A. DEFS Performance: Comply with the following:

1. Impact Performance: ASTM E 2568, High impact resistance unless otherwise indicated.
2. Adhesion: ASTM C-297, minimum 10psi.
3. Adhesion after 10 freeze/thaw cycles: ASTM C-297, minimum 10 psi.
4. Abrasion Resistance of Finish Coat: Sample consisting of 1/4-inch thick DEFS mounted on 5/8-inch thick gypsum board; cured for a minimum of 28 days and shows no cracking, checking, or loss of film integrity after exposure to 528 quarts (500 L) of sand when tested according to ASTM D 968, Method A.
5. Mildew Resistance of Finish Coat: Sample applied to 2-by-2-inch (50.8-by-50.8-mm) clean glass substrate; cured for 28 days and shows no growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274.

B. Component Performance – Finishes:
   1. Accelerated weathering: ASTM G-153, no deleterious effects (cracking checking crazing erosion, rusting, blistering, peeling or delamination) at 2000 hours when viewed under 5x.
   2. Freeze/Thaw Resistance: ICC-ES AC 59, no deleterious effects at 10 cycles.
   3. Mildew Resistance: ASTM D-3273, no growth supported during 28 day exposure period.
   4. Surface Burning: ASTM E-84
      a. Flame Spread: less than 25,
      b. Smoke Developed: less than 450

2.3 DEFS MATERIALS

A. Sheathing: Minimum 5/8-inch thick glass mat faced gypsum board complying with ASTM C117.
B. Drainage mat: maximum ¼ or 3/8 inch (6 or 10 mm) thick tangled filament nylon core with fabric facing.
C. Primer/Sealer: DEFS manufacturer's standard substrate conditioner designed to protect substrates from moisture penetration and to improve the bond between substrate and coating.
D. Reinforcing Mesh: Balanced, alkali-resistant, open-weave, glass-fiber mesh treated for compatibility with other DEFS materials, made from continuous multi-end strands with retained mesh tensile strength of not less than 120 lbf/in. (21 dN/cm) according to ASTM E2098/E2098M and the following:

   1. Reinforcing Mesh for DEFS, General: Not less than weight required to comply with impact-performance level specified in "Performance Requirements" Article.
   2. Detail-Reinforcing Mesh: Not less than 4.0 oz./sq. yd. (136 g/sq. m).
   3. Corner-Reinforcing Mesh: Not less than 7.2 oz./sq. yd. (244 g/sq. m).

E. Base Coat: DEFS manufacturer's standard mixture complying with the following:
   1. Factory-blended dry formulation of portland cement, dry polymer admixture, and inert fillers to which only water is added at Project site.

F. Primer: DEFS manufacturer's standard factory-mixed, elastomeric-polymer primer for preparing base-coat surface for application of finish coat.
G. Finish Coat: DEFS manufacturer's standard acrylic-based coating with enhanced mildew resistance complying with the following:

   1. Factory-mixed formulation of polymer-emulsion binder, colorfast mineral pigments, sound stone particles, and fillers.

      a. Aggregate: Marble chips of size and color as indicated by manufacturer's designations.

   2. Colors: As selected by Architect from manufacturer's full range.
   3. Textures: As indicated by manufacturer's designations.

4. Basis of Design: Sto Limestone Finish

H. Water: Potable.

I. Trim Accessories: Type as designated or required to suit conditions indicated and to comply with DEFS manufacturer's written instructions; manufactured from Aluminum.
   1. Drip Screed/Track: Prefabricated, one-piece type for attachment behind insulation, with face leg extended to form a drip, of depth required to suit thickness of coating and insulation, with face leg perforated for bonding to coating and back leg.
   2. Expansion Joint: Closed-cell polyethylene backer rod and elastomeric sealant, 3/4-inch (19-mm) minimum.

2.4 MIXING

A. Comply with DEFS manufacturer's requirements for combining and mixing materials. Do not introduce admixtures, water, or other materials, except as recommended by DEFS manufacturer. Mix materials in clean containers. Use materials within time period specified by EIFS manufacturer or discard.

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 roof edges, wall framing, flashings, openings, substrates, and junctures at other construction for suitable conditions where DEFS will be installed.

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

   1. Begin coating application only after surfaces are dry.
   2. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Protect contiguous work from moisture deterioration and soiling caused by application of DEFS. Provide temporary covering and other protection needed to prevent spattering of exterior finish coats on other work.

B. Protect DEFS, substrates, and wall construction behind them from inclement weather during installation. Prevent penetration of moisture behind DEFS and deterioration of substrates.

C. Prepare and clean substrates to comply with DEFS manufacturer's written instructions to obtain optimum bond between substrate and adhesive for insulation.

3.3 EIFS INSTALLATION, GENERAL

A. Comply with DEFS manufacturer's written instructions for installation of DEFS as applicable to each type of substrate.

3.4 SUBSTRATE PROTECTION APPLICATION

A. Primer/Sealer: Apply over gypsum sheathing substrates and where required by DEFS manufacturer for improving adhesion of coating to substrate.

3.5 TRIM INSTALLATION

A. Trim: Apply trim accessories at perimeter of DEFS, at expansion joints, and elsewhere as indicated. Coordinate with installation of sheathing.
   1. Expansion Joint: Use where indicated on Drawings.
   2. Casing Bead: Use at other locations.

3.6 BASE-COAT INSTALLATION

A. Base Coat: Apply to exposed surfaces of sheathing in minimum thickness recommended in writing by DEFS manufacturer, but not less than 1/16-inch (1.6-mm) dry-coat thickness.

B. Reinforcing Mesh: Embed reinforcing mesh in wet base coat to produce wrinkle-free installation with mesh continuous at corners, overlapped not less than 2-1/2 inches (64 mm) or otherwise treated at joints to comply with ASTM C1397 and DEFS manufacturer's written instructions. Do not lap reinforcing mesh within 8 inches (200 mm) of corners. Completely embed mesh, applying additional base-coat material if necessary, so reinforcing-mesh color and pattern are invisible.

C. Double-Layer Reinforcing-Mesh Application: Where indicated or required, apply second base coat and second layer of reinforcing mesh, overlapped not less than 2-1/2 inches (64 mm) or otherwise treated at joints to comply with ASTM C 1397 and DEFS manufacturer's written instructions in same manner as first application. Do not apply until first base coat has cured.

D. Additional Reinforcing Mesh: Apply strip reinforcing mesh around openings, extending 4 inches (100 mm) beyond perimeter. Apply additional 9-by-12-inch (230-by-300-mm) strip reinforcing mesh diagonally at corners of openings (re-entrant corners). Apply 8-inch- (200-mm-) wide, strip reinforcing mesh at both inside and outside corners unless base layer of mesh is lapped not less than 4 inches (100 mm) on each side of corners.

E. Double Base-Coat Application: Where indicated, apply second base coat in same manner and thickness as first application, except without reinforcing mesh. Do not apply until first base coat has cured.

3.7 FINISH-COAT APPLICATION

A. Primer: Apply over dry base coat according to DEFS manufacturer's written instructions.
B. Finish Coat: Apply over dry primed base coat, maintaining a wet edge at all times for uniform appearance, in thickness required by DEFS manufacturer to produce a uniform finish of color and texture matching approved sample and free of cold joints, shadow lines, and texture variations.

1. Embed aggregate in finish coat according to DEFS manufacturer's written instructions to produce a uniform applied-aggregate finish of color and texture matching approved sample.
2. Avoid application in direct sunlight.
3. Apply finish in a continuous application, always working to a wet edge.
4. Weather conditions affect application and drying time. Hot or dry conditions limit working time and accelerate drying and may require adjustments in the scheduling of work to achieve desired results; cool or damp conditions extend working time and retard drying and may require added measures of protection against wind, dust, dirt, rain and freezing. Adjust work schedule and provide protection.
5. Do not install finish on accessories.
6. Float "R" (rilled texture) with a plastic trowel to achieve their rilled texture.
7. Do not install separate batches of finish side by side.
8. Do not apply finish over irregular or unprepared surfaces or surfaces not in compliance with the project specifications.

3.8 CLEANING AND PROTECTION

A. Remove temporary covering and protection of other work. Promptly remove coating materials from window and door frames and other surfaces outside areas indicated to receive DEFS coatings.

END OF SECTION 072414

SECTION 072500 - WEATHER BARRIERS

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. Flexible flashing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Sustainable Design Submittals:

   1. Environmental Product Declaration: For each product.

PART 2 - PRODUCTS

2.1 FLEXIBLE FLASHING

A. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.040 inch (1.0 mm).

   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

      a. DuPont de Nemours, Inc.
      b. GCP Applied Technologies Inc.
      c. Protecto Wrap Company.
      d. Raven Industries, Inc.
      e. TYPAR.

   2. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.

B. Primer for Flexible Flashing: Product recommended in writing by flexible flashing manufacturer for substrate.

PART 3 - EXECUTION

3.1 FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.

1. Prime substrates as recommended by flashing manufacturer.
2. Lap seams and junctures with other materials at least 4 inches (100 mm) except that at flashing flanges of other construction, laps need not exceed flange width.
3. Lap flashing over water-resistive barrier at bottom and sides of openings.
4. Lap water-resistive barrier over flashing at heads of openings.
5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

END OF SECTION 072500

SECTION 072600 – UNDER SLAB VAPOR BARRIER

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. Products furnished under this section, and installed in coordination with related sections include the following:

1. Vapor barrier, seam tape, vapor proofing mastic, pipe boots, detail strip for installation under concrete slabs.

B. Related Sections:

1. Division 03 Section "Cast-In-Place Concrete" for concrete floor slabs.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Material Certificates: For each product, signed by manufacturers.
C. Samples for verification: (2) - 6" x 6" samples of plastic vapor barrier, seamed together along one side using manufacturer's seam tape, to form a single 6" x 12" sample.
D. Sustainable Design Submittals:

1. Environmental Product Declaration: For each product.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain primary materials and accessories through one source from a single manufacturer.

1.5 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit vapor retarder to be installed according to manufacturers' written instructions.

PART 2 - PRODUCTS

2.1 PLASTIC VAPOR BARRIER

A. Vapor barrier membrane that meets or exceeds the following properties:

1. Permeance rating: ASTM E 96 or ASTM F 1249, meets permeance requirements for both new material, and after ASTM E-1745 mandatory conditioning tests (ASTM E 154; Sections 8, 11, 12, 13):

   a. New material: Less than 0.01 perms.
   b. After conditioning: Less than 0.01 perms.

2. Water Vapor Retarder: ASTM E 1745, Class A
3. Minimum thickness : 15 mils, ACI 302.1R-06.
4. Manufactured from prime virgin resins.
5. Woven materials are not acceptable.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. StegoWrap, Stego Industries LLC.
2. VaporBlock VB15, Raven Industries.
3. Viper VaporCheck II, Insulation Solutions, Inc.

2.2 MISCELLANEOUS MATERIALS

A. Seam Tape: ASTM E 96, Water Vapor Transmission Rate 0.3 perms or lower.
B. Vapor Proofing mastic: ASTM E 96, Water Vapor Transmission Rate 0.3 perms or lower.
C. Pipe boots: Construct pipe boots from vapor retarder material, pressure sensitive tape and/or mastic per manufacturer's instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine slab base course, with Installer present, for compliance with requirements for surface stability and other conditions affecting performance of work.

1. Proceed with vapor barrier installation only after base course construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Coordinate installation of the under slab vapor barrier in conjunction with the drawings and with the work specified in Division 3, Section 03 30 00 "Cast-In-Place Concrete".
B. Comply with manufacturer's written recommendations and ASTM E 1643-98 (2005), unless more stringent requirements are indicated or required by Project conditions to ensure satisfactory performance of vapor barrier.

1. Unroll vapor barrier with the longest dimension parallel in the direction of the concrete pour.
2. Lap vapor barrier over footings or seal to foundation walls.
3. Overlap joints 6 inches and seal with manufacturer's tape.
4. Seal all penetrations (including pipes) per manufacturer's instructions.
5. Do not penetrate the vapor barrier except where necessary for reinforcing steel and permanent utilities.
6. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6 inches and taping all four sides with seam tape.

END OF SECTION 072600

SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Medium-build air barriers, vapor permeable.

B. Related Requirements:

   1. Section 061600 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.
   2. Section 072500 "Weather Barriers" for weather barriers, including flexible flashing and building wraps with air-barrier properties.

1.2 DEFINITIONS

A. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
B. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.
C. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

   1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.4 ACTION SUBMITTALS

A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.
   1. Medium-build air barriers, vapor permeable.

B. Shop Drawings: For air-barrier assemblies.

   1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.

2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
3. Include details of interfaces with other materials that form part of air barrier.

C. Sustainable Design Submittals:

1. Environmental Product Declaration: For each product.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer. Include list of ABAA-certified installers and supervisors employed by Installer, who work on Project.
B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.
C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.
D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1. Installer to be licensed by ABAA in accordance with ABAA's Quality Assurance Program and to employ ABAA-certified installers and supervisors on Project.

B. Mockups: Build mockups to set quality standards for materials and execution.

1. Build integrated mockups of exterior wall assembly as indicated on Drawings, incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.

a. Coordinate construction of mockups to permit inspection of air barrier before external insulation and cladding are installed.
b. Include junction with roofing membrane, building corner condition, and foundation wall intersection.
c. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Remove and replace liquid materials that cannot be applied within their stated shelf life.
B. Protect stored materials from direct sunlight.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.

1. Protect substrates from environmental conditions that affect air-barrier performance.
2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain primary air-barrier materials and air-barrier accessories from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction to be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies to be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa), when tested in accordance with ASTM E2357.
C. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75 Pa) pressure difference; ASTM E2178.
D. Ultimate Elongation: Minimum 200 percent; ASTM D412, Die C.
E. Adhesion to Substrate: Minimum 16 lbf/sq. in. (110 kPa) when tested in accordance with ASTM D4541.
F. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
G. UV Resistance: Can be exposed to sunlight for 90 days in accordance with manufacturer's written instructions.

2.3 MEDIUM-BUILD AIR BARRIERS, VAPOR PERMEABLE

A. Medium-Build, Vapor-Permeable Air Barrier: Synthetic polymer material with an installed dry film thickness, according to manufacturer's written instructions, of 16 to 34 mils (0.41 to 0.86 mm) over smooth, void-free substrates.

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. 3M Industrial Adhesives and Tapes Division.
    b. Carlisle Coatings & Waterproofing Inc.
    c. DuPont de Nemours, Inc.
    d. Hohmann & Barnard, Inc.
    e. W. R. Meadows, Inc.
2. Vapor Permeance: Minimum 5 perms (290 ng/Pa x s x sq. m); ASTM E96/E96M, Procedure A, Desiccant Method.

2.4 ACCESSORY MATERIALS

A. Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.

C. Stainless Steel Sheet: ASTM A240/A240M, Type 304, 0.0187 inch (0.5 mm) thick, and Series 300 stainless steel fasteners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
3. Verify that substrates are visibly dry and free of moisture. Test concrete substrates for capillary moisture by plastic sheet method in accordance with ASTM D4263.
4. Verify that masonry joints are flush and completely filled with mortar.

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

3.2 SURFACE PREPARATION

A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate in accordance with manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.
B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.
E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.
H. Bridge isolation joints expansion joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement in accordance with manufacturer's written instructions and details.

3.3 INSTALLATION OF ACCESSORIES

A. Install accessory materials in accordance with air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.

    1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
    2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate.
    3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
    4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.

B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and

window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

D. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate. Maintain 3 inches (75 mm) of full contact over firm bearing to perimeter frames, with not less than 1 inch (25 mm) of full contact.

1. Transition Strip: Roll firmly to enhance adhesion.

F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.

G. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

H. Seal top of through-wall flashings to air barrier with an additional 6-inch- (150-mm-) wide, transition strip.

I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches (150 mm) beyond repaired areas in strip direction.

3.4 INSTALLATION OF PRIMARY AIR-BARRIER MATERIAL

A. Apply air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier in accordance with air-barrier manufacturer's written instructions and details. Apply air-barrier material within manufacturer's recommended application temperature ranges.

1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
2. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.

B. Medium-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply an increased thickness of air-barrier material in full contact around protrusions such as masonry ties.
   1. Vapor-Permeable, Medium-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, applied in one or more equal coats. Apply additional material as needed to achieve void- and pinhole-free surface, but do not exceed thickness on which required vapor permeability is based.

C. Do not cover air barrier until it has been tested and inspected by testing agency.
D. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.5 FIELD QUALITY CONTROL

A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.
B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
C. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:

   1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
   2. Air-barrier dry film thickness.
   3. Continuous structural support of air-barrier system has been provided.
   4. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
   5. Site conditions for application temperature and dryness of substrates have been maintained.
   6. Maximum exposure time of materials to UV deterioration has not been exceeded.
   7. Surfaces have been primed, if applicable.
   8. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
   9. Termination mastic has been applied on cut edges.
   10. Strips and transition strips have been firmly adhered to substrate.
   11. Compatible materials have been used.
   12. Transitions at changes in direction and structural support at gaps have been provided.
   13. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
   14. All penetrations have been sealed.

D. Tests: As determined by testing agency from among the following tests:
   1. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to substrate in accordance with ASTM D4541 for each 600 sq. ft. (56 sq. m) of installed air barrier or part thereof.

E. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, in accordance with manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

F. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.
G. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, in accordance with manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials in accordance with air-barrier manufacturer's written instructions.
2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.
C. Remove masking materials after installation.

END OF SECTION 072726

SECTION 073113 - ASPHALT SHINGLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass-fiber-reinforced asphalt shingles.
2. Underlayment materials.
3. Ridge vents.
4. Metal flashing and trim.

1.2 DEFINITIONS

A. Roofing Terminology: See ASTM D1079 for definitions of terms related to roofing Work in this Section.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Asphalt shingles.
2. Underlayment materials.
3. Ridge vents.
4. Asphalt roofing cement.
5. Elastomeric flashing sealant.

B. Sustainable Design Documentation:
1. Environmental Product Declaration.

C. Shop Drawings: For metal flashing and trim.

D. Samples for Initial Selection:

1. For each type of asphalt shingle indicated.
2. For each type of accessory involving color selection.

E. Samples for Verification: For the following products, in sizes indicated:

1. Asphalt Shingles: Full size.

2. Ridge and Hip Cap Shingles: Full size.
3. Ridge Vent: 12-inch- (305-mm-) long Sample.

F. Sustainable Design Submittals:
1. "Sustainable Design Requirements – Green Globes 2021" to validate the credits claimed to achieve Green Globes goals.
   a. Cradle-to-Gate Product Life Cycle certifications, where available.
   b. Recycled Content:, pre- and post-consumer content, where available.
   c. Sealants: Indicate VOC content.
   d. Environmental Product Declaration: For each product.

2. VOC Content for each product.
3. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.
B. Product Test Reports: For each type of asphalt shingle and underlayment product indicated, for tests performed by manufacturer and witnessed by a qualified testing agency.
C. Research Reports: For synthetic underlayment, from ICC-ES, indicating that product is suitable for intended use under applicable building codes.
D. Sample Warranty: For manufacturer's materials warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For asphalt shingles to include in maintenance manuals.
B. Materials warranties.
C. Roofing Installer's warranty.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Asphalt Shingles: 100 sq. ft. (9.3 sq. m) of each type and in each color and blend, in unbroken bundles.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An authorized installer who is trained and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store roofing materials in a dry, well-ventilated location protected from weather, sunlight, and moisture in accordance with manufacturer's written instructions.
B. Store underlayment rolls on end, on pallets or other raised surfaces. Do not double-stack rolls.
C. Protect unused roofing materials from weather, sunlight, and moisture when left overnight or when roofing Work is not in progress.
D. Handle, store, and place roofing materials in a manner to prevent damage to roof deck or structural supporting members.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Proceed with installation only when existing and forecasted weather conditions permit product installation and related Work to be performed in accordance with manufacturer's written instructions and warranty requirements.

1. Install self-adhering, polymer-modified bitumen sheet underlayment within the range of ambient and substrate temperatures recommended in writing by manufacturer.

1.11 WARRANTY

A. Materials Warranty: Manufacturer agrees to repair or replace asphalt shingles that fail within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Manufacturing defects.

2. Materials Warranty Period: 50 years from date of Substantial Completion, prorated, with first 20 years nonprorated.
3. Wind-Speed Warranty Period: Asphalt shingles will resist blow-off or damage caused by wind speeds of up to 135 mph (60 m/s) for 10 years from date of Substantial Completion.
4. Algae-Resistance Warranty Period: Asphalt shingles will not discolor for 25 years from date of Substantial Completion.
5. Workmanship Warranty Period: 20 years from date of Substantial Completion.

B. Roofing Installer's Warranty: On warranty form at end of this Section, signed by Installer, in which Installer agrees to repair or replace components of asphalt shingle roofing that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of product from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Exterior Fire-Test Exposure: Provide asphalt shingles and related roofing materials identical to those of assemblies tested for Class A fire resistance in accordance with ASTM E108 or UL 790 by Underwriters Laboratories or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

B. Wind Resistance: Provide asphalt shingles that comply with requirements of ASTM D3161/D3161M, Class F, and with ASTM D7158/D7158M, Class H.

C. Energy Performance, ENERGY STAR: Provide asphalt shingles that are listed on the DOE's "ENERGY STAR Roof Product List" for steep-slope roof products.

2.3 GLASS-FIBER-REINFORCED ASPHALT SHINGLES

A. Laminated-Strip Asphalt Shingles: ASTM D3462/D3462M, laminated, multi-ply overlay construction; glass-fiber reinforced, mineral-granule surfaced, and self-sealing.

1. Basis-of-Design Product: Subject to compliance with requirements, provide GAF Materials Corporation; Timberline HD Lifetime High Definition Shingles or comparable product by one of the following:
   a. Atlas Roofing Corporation.
   b. CertainTeed Corporation.
   c. Owens Corning.
2. Butt Edge: Straight cut.
3. Strip Size: Manufacturer's standard.
4. Algae Resistance: Granules resist algae discoloration.
5. Color and Blends: Charcoal

B. Hip and Ridge Shingles: Manufacturer's standard units to match asphalt shingles.

2.4 UNDERLAYMENT MATERIALS

A. Organic Felt: Asphalt-saturated organic felts, nonperforated and complying with the following:

1. ASTM D226/D226M: Type II.

B. Self-Adhering, Polymer-Modified Bitumen Sheet: ASTM D1970/D1970M, minimum 55-mil-(1.4-mm-) thick sheet; glass-fiber-mat-reinforced, polymer-modified asphalt; with slip-resistant top surface and release backing; cold applied.

1. Basis-of-Design Product: Subject to compliance with requirements, provide GAF Materials Corporation StormGuard or comparable product by one of the following:
   a. Atlas Roofing Corporation.
   b. Carlisle Coatings & Waterproofing, Inc.
   c. CertainTeed Corporation.
   d. Johns Manville.
   e. Owens Corning.

C. Granular-Surfaced Valley Lining: ASTM D6380/D6380M, Class M, organic-felt-based, asphalt roll roofing; 36 inches (914 mm) wide.

2.5 RIDGE VENTS

A. Rigid Ridge Vent: Manufacturer's standard, rigid-section, high-density, UV-stabilized plastic ridge vent for use under ridge shingles.
   1. Features:
      a. Nonwoven geotextile filter strips.
      b. External deflector baffles.

2.6 ACCESSORIES

A. Asphalt Roofing Cement: ASTM D4586/D4586M Type II, asbestos free.
B. Elastomeric Flashing Sealant: ASTM C920, Type S, Grade NS, one-part, non-sag, elastomeric polymer sealant; of class and use classifications required to seal joints and remain watertight; recommended in writing by manufacturer for installation of flashing systems.
C. Roofing Nails: ASTM F1667, aluminum, stainless steel, copper, or hot-dip galvanized-steel wire shingle nails, minimum 0.120-inch- (3-mm-) diameter, sharp-pointed, with a 3/8- to 7/16-inch- (10- to 11-mm-) diameter flat head and of sufficient length to penetrate 3/4 inch (19 mm) into solid wood decking or extend at least 1/8 inch (3 mm) through sheathing less than 3/4 inch (19 mm) thick.
   1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.

D. Underlayment Nails: Aluminum, stainless steel, or hot-dip galvanized-steel wire nails with low-profile metal or plastic caps, 1-inch- (25-mm-) minimum diameter.
   1. Provide with minimum 0.0134-inch- (0.34-mm-) thick metal cap, 0.010-inch- (0.25-mm-) thick power-driven metal cap, or 0.035-inch- (0.89-mm-) thick plastic cap; and with minimum 0.083-inch- (2.11-mm-) thick ring shank or 0.091-inch- (2.31-mm-) thick smooth shank of length to penetrate at least 3/4 inch (19 mm) into roof sheathing or to penetrate through roof sheathing less than 3/4 inch (19 mm) thick.

2.7 METAL FLASHING AND TRIM

A. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."

1. Sheet Metal: Aluminum, mill finished.

B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of the item unless otherwise specified in this Section or indicated on Drawings.

1. Drip Edges: Fabricate in lengths not exceeding 10 feet (3 m) with minimum 2-inch (51-mm) roof-deck flange and 1-1/2-inch (38-mm) fascia flange with 3/8-inch (10-mm) drip at lower edge.
2. Vented Drip Edge: Fabricate in lengths not exceeding 10 feet (3 m) with minimum 6-inch roof-deck flange and 2-inch fascia flange with 3/8-inch (10-mm) drip at lower edge.
   a. Air Vent Pro Flo or approved equal
   b. Aluminum, white finish
3. Vent-Pipe Flashings: ASTM B749, Type L51121, at least 1/16 inch (1.6 mm) thick. Provide lead sleeve sized to slip over and turn down into pipe, soldered to skirt at slope of roof, and extending at least 4 inches (102 mm) from pipe onto roof.

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.

1. Examine roof sheathing to verify that sheathing joints are supported by framing and blocking or metal clips and that installation is within flatness tolerances.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored and that provisions have been made for flashings and penetrations through asphalt shingles.
3. Verify that vent stacks and other penetrations through roofing are installed and securely fastened.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2 INSTALLATION OF UNDERLAYMENT MATERIALS

A. Comply with asphalt shingle and underlayment manufacturers' written installation instructions and with recommendations in NRCA's "The NRCA Roofing Manual: Steep-Slope Roof

Systems" applicable to products and applications indicated unless more stringent requirements are specified in this Section or indicated on Drawings.

1. Install felt underlayment over areas protected by self-adhering, polymer-modified bitumen sheet unless otherwise specified in this Section or indicated on Drawings.

    a. Lap sides of felt over self-adhering sheet not less than 4 inches (102 mm) in direction that sheds water.
    b. Lap ends of felt not less than 6 inches (152 mm) over self-adhering sheet.

2. Install fasteners in a grid pattern of 12 inches (305 mm) between side laps with 6-inch (152-mm) spacing at side and end laps.
3. Terminate felt extended up not less than 4 inches (102 mm) against sidewalls, curbs, chimneys, and other roof projections.

B. Self-Adhering, Polymer-Modified Bitumen Sheet: Install, wrinkle free, on entire roof deck.

1. Comply with low-temperature installation restrictions of underlayment manufacturer.
2. Install lapped in direction that sheds water.

    a. Lap sides not less than 4 inches (102 mm).
    b. Lap ends not less than 6 inches (152 mm), staggered 24 inches (610 mm) between succeeding courses.
    c. Roll laps with roller.
3. Cover underlayment within seven days.

3.3 INSTALLATION OF METAL FLASHING AND TRIM

A. Install metal flashings and trim to comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."

1. Install metal flashings in accordance with recommendations in ARMA's "Asphalt Roofing Residential Manual - Design and Application Methods" and NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."
2. Bed flanges of metal flashings using asphalt roofing cement or elastomeric flashing sealant.

B. Cricket and Backer Flashings: Install against roof-penetrating elements extending concealed flange beneath upslope asphalt shingles and beyond each side.
C. Counterflashings: Coordinate with installation of base flashing and fit tightly to base flashing. Lap joints a minimum of 4 inches (102 mm) secured in a waterproof manner.

1. Install in reglets or receivers.

D. Rake Drip Edges: Install over underlayment materials and fasten to roof deck.
E. Eave Drip Edges: Install below underlayment materials and fasten to roof deck.

F. Pipe Flashings: Form flashing around pipe penetrations and asphalt shingles. Fasten and seal to asphalt shingles as recommended by manufacturer.

3.4 INSTALLATION OF ASPHALT SHINGLES

A. Install asphalt shingles in accordance with manufacturer's written instructions and recommendations in ARMA's "Asphalt Roofing Residential Manual - Design and Application Methods" and NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."

B. Install starter strip along lowest roof edge, consisting of an asphalt shingle strip at least 7 inches (178 mm) wide with self-sealing strip face up at roof edge.

1. Extend asphalt shingles 3/4 inch (19 mm) over fasciae at eaves and rakes.
2. Install starter strip along rake edge.

C. Install first and remaining courses of laminated asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.

D. Fasten asphalt shingle strips with a minimum of six roofing nails, but not less than the number indicated in manufacturer's written instructions for roof slope and design wind speed indicated on Drawings and for warranty requirements specified in this Section.

1. Locate fasteners in accordance with manufacturer's written instructions.
2. Where roof slope is less than 4:12, hand seal self-sealing asphalt shingles to improve the shingles' positive bond by applying asphalt roofing cement spots between course overlaps after nailing the upper course.
3. When ambient temperature during installation is below 50 deg F (10 deg C), hand seal self-sealing asphalt shingles by applying asphalt roofing cement spots between course overlaps after nailing the upper course.

E. Closed-Cut Valleys: Extend asphalt shingle strips from one side of valley 12 inches (305 mm) beyond center of valley.

1. Use one-piece shingle strips without joints in valley.
2. Fasten with extra nail in upper end of shingle. Install asphalt shingle courses from other side of valley and cut back to a straight line 2 inches (51 mm) short of valley centerline.
3. Trim upper concealed corners of cut-back shingle strips.
4. Do not nail asphalt shingles within 6 inches (152 mm) of valley center.
5. Set trimmed, concealed-corner asphalt shingles in a 3-inch- (76-mm-) wide bed of asphalt roofing cement.

F. Ridge Vents: Install continuous ridge vents over asphalt shingles in accordance with manufacturer's written instructions. Fasten with roofing nails of sufficient length to penetrate sheathing.

G. Hip and Ridge Shingles: Maintain same exposure of cap shingles as roofing-shingle exposure. Lap cap shingles at ridges to shed water away from direction of prevailing winds.

1. Fasten with roofing nails of sufficient length to penetrate sheathing.
2. Fasten ridge cap asphalt shingles to cover ridge vent without obstructing airflow.

3.5 ROOFING INSTALLER'S WARRANTY

A. WHEREAS <**Insert name**> of <**Insert address**>, herein called the "Roofing Installer," has performed roofing and associated work ("the work") on the following project:

1. Owner: <**Insert name of Owner**>.
2. Owner Address: <**Insert address**>.
3. Building Name/Type: <**Insert information**>.
4. Building Address: <**Insert address**>.
5. Area of the Work: <**Insert information**>.
6. Acceptance Date: <**Insert date**>.
7. Warranty Period: <**Insert time**>.
8. Expiration Date: <**Insert date**>.

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant the work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that, during Warranty Period, Roofing Installer will, at Roofing Installer's own cost and expense, make or cause to be made such repairs to or replacements of the work as are necessary to correct faulty and defective work and as are necessary to maintain the work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to the work and other parts of the building, and to building contents, caused by:

    a. Lightning;
    b. Peak gust wind speed exceeding <**Insert wind speed**> mph (m/s);
    c. Fire;
    d. Failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
    e. Faulty construction of copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
    f. Vapor condensation on bottom of roofing; and
    g. Activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When the work has been damaged by any of foregoing causes, Warranty is to be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.

3. Roofing Installer is responsible for damage to the work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of the work.
4. During Warranty Period, if Owner allows alteration of the work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty becomes null and void on date of the alterations, but only to the extent the alterations affect the work covered by this Warranty. If Owner engages Roofing Installer to perform the alterations, Warranty does not become null and void unless Roofing Installer, before starting the alterations, notified Owner in writing, showing reasonable cause for claim, that the alterations would likely damage or deteriorate the work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a use or service more severe than originally specified, this Warranty becomes null and void on date of the change, but only to the extent the change affects the work covered by this Warranty.
6. Owner promptly notifies Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and affords reasonable opportunity for Roofing Installer to inspect the work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on the work and does not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty does not operate to relieve Roofing Installer of responsibility for performance of the work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this <**Insert day**> day of <**Insert month**>, <**Insert year**>.

1. Authorized Signature: <**Insert signature**>.
2. Name: <**Insert name**>.
3. Title: <**Insert title**>.

END OF SECTION 073113

SECTION 075216 - STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS MEMBRANE ROOFING

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. Styrene-butadiene-styrene (SBS)-modified bituminous membrane roofing.
2. Vapor retarder.
3. Roof insulation.
4. Cover board in hot asphalt or Insulation adhesive
5. Base Ply Adhered in hot asphalt or Heat Welded
6. Cap ply Heat Welded
7. Walkways.

B. Section includes the installation of sound-absorbing insulation strips in ribs of roof deck. Sound-absorbing insulation strips are furnished under Section 053100 "Steel Decking."

C. Related Requirements:
1. Section 061053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking, and for wood-based, structural-use roof deck panels.
2. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
3. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.3 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D1079 and glossary of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

1.4 PREINSTALLATION MEETINGS

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

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.

2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof system component fasteners, include copy of SPRI's Directory of Roof Assemblies listing.

B. Shop Drawings: Include plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane terminations.
3. Flashing details at penetrations.
4. Tapered insulation, including slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
6. Crickets, saddles, and tapered edge strips, including slopes.
7. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
8. Tie-in with adjoining air barrier.

C. Samples for Verification: For the following products:

1. Cap Sheet: Samples of manufacturer's standard colors for selection by Architect.

D. Wind Uplift Resistance Submittal: For roofing system indicating compliance with wind uplift performance requirements.

E. Sustainable Design Submittals:

1. "Sustainable Design Requirements – Green Globes 2021" to validate the credits claimed to achieve Green Globes goals.
   a. Cradle-to-Gate Product Life Cycle certifications, where available.
   b. Recycled Content:, pre- and post-consumer content, where available.
   c. Sealants: Indicate VOC content.
   d. Environmental Product Declaration: For each product.

2. VOC Content for each product.
3. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.
B. Manufacturer Certificates:
   1. Performance Requirement Certificate: Signed by roof membrane manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
      a. Submit evidence of complying with performance requirements.
   2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.
C. Product Test Reports: For roof membrane and insulation, tests performed by a qualified testing agency, indicating compliance with specified requirements.
D. Evaluation Reports: For components of membrane roofing system, from ICC-ES.
E. Field Test Reports:
   1. Concrete internal relative humidity test reports.
   2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.
F. Field quality-control reports.
G. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is listed in SPRI's Directory of Roof Assemblies for roofing system identical to that used for this Project.
B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.

1. Protect stored liquid material from direct sunlight.
2. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources.

1. Store in a dry location.
2. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, cover boards, vapor retarder, substrate board, and other components of roofing system.
2. Warranty Period: 20 years from date of Substantial Completion.

B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as roof membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, and walkway products, for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing system and flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings shall remain watertight.

1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746/D3746M, ASTM D4272/D4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

C. Wind Uplift Resistance: Design roofing system to resist wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:

1. Zone 1 (Roof Area Field): See Drawings
2. Zone 2 (Roof Area Perimeter): See Drawings
3. Zone 3 (Roof Area Corners): See Drawings

D. SPRI's Directory of Roof Assemblies Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system and shall be listed in SPRI's Directory of Roof Assemblies for roof assembly identical to that specified for this Project.
1. Wind Uplift Load Capacity: 105 psf.

E. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency.

1. Identify products with appropriate markings of applicable testing agency.

F. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated.

1. Identify products with appropriate markings of applicable testing agency.

2.2 MANUFACTURERS

A. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturer approved by roof membrane manufacturer.

2.3 BASE SHEET MATERIALS

A. SBS-Modified Bitumen Fiberglass Mat Base Sheet: ASTM D 6163/D 6163M, Type I, Grade S, SBS-modified asphalt sheet, reinforced with fiberglass fabric, smooth surfaced, suitable for cold adhesive or hot asphalt application method.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Garland Company, (The);
   b. Johns Manville; a Berkshire Hathaway company.
   c. Siplast, Inc.
   d. Soprema, Inc.

B. SBS-Modified Bitumen Fiberglass Mat Base Sheet: ASTM D 6163/D 6163M, Type I, Grade S, SBS-modified asphalt sheet, reinforced with fiberglass fabric, smooth surfaced, suitable for cold adhesive or hot asphalt application method.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Garland Company, (The);
   b. Johns Manville; a Berkshire Hathaway company.
   c. Siplast, Inc.
   d. Soprema, Inc.

2.4 STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS CAP SHEET

A. Granule-Surfaced Roofing Cap Sheet: ASTM D 6163/D 6163M, Type I, Grade G, SBS-modified asphalt sheet, reinforced with fiberglass fabric, suitable for torch application method.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Garland Company, (The);
   b. Johns Manville; a Berkshire Hathaway company.
   c. Siplast, Inc.
   d. Soprema, Inc.

2. Granule Color: White.

2.5 BASE FLASHING SHEET MATERIALS

A. Backer Sheet: ASTM D 6164/D 6164M, Type I, Grade S, SBS-modified asphalt sheet, reinforced with polyester fabric, smooth surfaced, suitable for application method specified. 150 mil thickness minimum.

B. Granule-Surfaced Flashing Sheet: ASTM D 6164/D 6164M, Type I, Grade G, SBS-modified asphalt sheet, reinforced with polyester fabric, granule surfaced, suitable for application method specified, and as follows:

1. Granule Color: White.

C. Glass-Fiber Fabric: Woven glass-fiber cloth, treated with asphalt, complying with ASTM D 1668/D 1668M, Type I.
D. Liquid Flashing System: Roof membrane manufacturer's standard one- or two-part moisture curing resin with low solvent content, consisting of a primer, flashing cement, and scrim.

2.6 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
B. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.
C. Cold-Applied Asphalt Adhesive: ASTM D3019, Type III, roof membrane manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with roofing membrane and base flashings.
D. Cold-Applied Polymer-Modified Asphalt Adhesive: Roof membrane manufacturer's standard solvent-and asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with interply sheets and aggregate surfacing adhesive.
E. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required by roofing system manufacturer for application.
F. Mastic Sealant: Polyisobutylene, plain or modified bitumen; nonhardening, nonmigrating, nonskinning, and nondrying.
G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate; tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.
H. Roofing Granules: Ceramic-coated roofing granules, No. 11 screen size with 100 percent passing No. 8 (2.36-mm) sieve and 98 percent of mass retained on No. 40 (0.425-mm) sieve; color to match roof membrane. Color: White.
I. Miscellaneous Accessories: Provide those recommended by roofing system manufacturer.

2.7 VAPOR RETARDER

A. SBS-modified bitumen self-adhered vapor retarder, air barrier membrane with release film on the bottom surface and a tri-laminate woven polyethylene film top surface reinforcement.
   1. Thickness: 31.5 mils (0.80 mm)
   2. Width: 45 in (1.14 m)
   3. Length: 133 ft (40.8 m)

B. SBS-Modified Bitumen Fiberglass Mat Base Sheet: ASTM D 6163/D 6163M, Type I, Grade S, SBS-modified asphalt sheet, reinforced with fiberglass fabric, smooth surfaced, suitable for cold adhesive or hot asphalt application method.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. Garland Company, (The);
      b. Johns Manville; a Berkshire Hathaway company.
      c. Siplast, Inc.
      d. Soprema, Inc.

2.8 ROOF INSULATION

A. General: Preformed roof insulation boards, manufactured or approved by roof membrane manufacturer, , approved for use in SPRI's Directory of Roof Assemblies listed roof assemblies.

B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.

   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. Dyplast Products.
      b. Johns Manville; a Berkshire Hathaway company.
      c. Soprema, Inc.

   2. Compressive Strength: 20 psi (138 kPa).
   3. Size: 48 by 96 inches (1219 by 2438 mm).
   4. Thickness:

      a. Base Layer: 2 inches.
      b. Upper Layer:2 inches.

C. Tapered Insulation: Provide factory-tapered insulation boards.

   1. Material: Match roof insulation.
   2. Minimum Thickness: 1/4 inch (6 mm).
   3. Slope:

a. Roof Field: 1/4 inch per foot (1:48) unless otherwise indicated on Drawings.
b. Saddles and Crickets: 1/2 inch per foot (1:24) unless otherwise indicated on Drawings.

2.9 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.
B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.
C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:

1. Modified asphaltic, asbestos-free, cold-applied adhesive.
2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
3. Full-spread spray-applied, low-rise, two-component urethane adhesive.

D. Insulation Cant Strips: ASTM C728, perlite insulation board.
E. Insulation Cant Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.
F. Wood Nailer Strips: Comply with requirements in Section 061053 "Miscellaneous Rough Carpentry."
G. Tapered Edge Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.
H. Cover Board: Asphaltic saturated fiberglass fiberboard, 1/8-inch thick, having a minimum compression strength of 1600 psi.

2.10 ASPHALT MATERIALS

A. Asphalt Primer: ASTM D41/D41M.
B. Roofing Asphalt: ASTM D312/D312M, Type III or IV as recommended by roofing system manufacturer for application.
C. Roofing Asphalt: ASTM D6152/D6152M, SEBS modified.

2.11 WALKWAYS

A. Walkway Cap-Sheet Strips: ASTM D6164/D6164M, Type I or II, Grade G, SBS-modified asphalt sheet (reinforced with polyester fabric); granule surfaced; suitable for application method specified, and as follows:

1. Size: 36 by 60 inches (914 mm by 1524 mm).

2. Granule Color: White.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
2. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."
4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
5. Verify that concrete substrate is visibly dry and free of moisture, and that minimum concrete internal relative humidity is not more than 75 percent, or as recommended by roofing system manufacturer, when tested according to ASTM F2170.

    a. Test Frequency: One test probe per each 1000 sq. ft. (93 s2. m), or portion thereof, of roof deck, with not less than three test probes.
    b. Submit test reports within 24 hours of performing tests.

6. Verify that concrete-curing compounds that impair adhesion of roofing components to roof deck have been removed.
7. Verify that minimum curing period recommended by roofing system manufacturer for lightweight insulating concrete roof decks has passed.

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

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions.

1. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction.

1. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Prime surface of concrete deck with asphalt primer at a rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m), and allow primer to dry.

D. Perform fastener-pullout tests according to roof system manufacturer's recommendations.

1. Submit test result within 24 hours of performing tests.

a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

E. Install sound absorbing insulation strips in ribs of acoustical roof decks according to acoustical roof deck manufacturer's written instructions.

3.3 INSTALLATION OF ROOFING, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, SPRI's Directory of Roof Assemblies listed roof assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.
B. Complete terminations and base flashings, and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast.

1. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified in Section 072726 "Fluid-Applied Membrane Air Barriers."
D. Asphalt Heating:

1. Heat asphalt to its equiviscous temperature, measured at the mop cart or mechanical spreader immediately before application.

a. For cap sheets, heat asphalt according to cap sheet manufacturer's recommendations.

2. Circulate asphalt during heating.
3. Do not raise asphalt temperature above equiviscous temperature range more than one hour before time of application.

a. For cap sheets, cold adhesives shall be used per manufacturer's recommendations.

4. Do not exceed asphalt manufacturer's recommended temperature limits during asphalt heating.
5. Do not heat asphalt within 25 deg F (14 deg C) of flash point.
6. Discard asphalt maintained at a temperature exceeding finished blowing temperature for more than four hours.
7. Apply hot roofing asphalt within plus or minus 25 deg F (14 deg C) of equiviscous temperature.

a. For cap sheets, comply with cap sheet manufacturer's recommendations.

E. Asphalt Heating: Heat and apply SEBS-modified roofing asphalt according to roofing system manufacturer's written instructions.
F. Substrate-Joint Penetrations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

3.4 INSTALLATION OF INSULATION

A. Coordinate installing roofing system components, so insulation is not exposed to precipitation or left exposed at the end of the workday.
B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.
C. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of roofing system with vertical surfaces or angle changes greater than 45 deg F (14 deg C).
D. Installation Over Metal Decking:

1. Install base layer of insulation with end joints staggered not less than 12 inches (300 mm) in adjacent rows.
   a. Locate end joints over crests of decking.
   b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
   c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
   d. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).
      1) Trim insulation, so that water flow is unrestricted.
   e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
   f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
   g. Mechanically attach base layer of insulation using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.
      1) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install upper layers of insulation and tapered insulation, with joints of each layer offset not less than 12 inches (300 mm) from previous layer of insulation.
   a. Install with long joints continuous and with end joints staggered not less than 12 inches (300 mm) in adjacent rows.
   b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
   c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.

d. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).
e. Trim insulation, so that water flow is unrestricted.
f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
h. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.

E. Installation Over Concrete Decks:

1. Install base layer of insulation with end joints staggered not less than 12 inches (300 mm) in adjacent rows.

a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
b. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
c. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).

1) Trim insulation, so that water flow is unrestricted.

d. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
e. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
f. Adhere base layer of insulation to concrete roof deck according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

1) Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m), and allow primer to dry.
2) Set insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
3) Set insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

2. Install upper layers of insulation and tapered insulation, with joints of each layer offset not less than 12 inches (300 mm) from previous layer of insulation.

a. Install with long joints continuous and with end joints staggered not less than 12 inches (300 mm) in adjacent rows.
b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
d. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).

1) Trim insulation, so that water flow is unrestricted.

e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
g. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
2) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.5 INSTALLATION OF COVER BOARDS

A. Install cover boards over insulation with long joints in continuous straight lines, with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction.

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
2. At internal roof drains, conform to slope of drain sump.

a. Trim cover board, so that water flow is unrestricted.

3. Cut and fit cover board tight to nailers, projections, and penetrations.
4. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

a. Set cover board in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
b. Encapsulation of gypsum coverboard with hot asphalt is strictly prohibited

3.6 INSTALLATION OF ROOFING MEMBRANE, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions and applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."

B. Coordinate installation of roofing system so insulation and other components of the roofing system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.

1. Provide tie-offs at end of each day's work to cover exposed roofing sheets and insulation with a course of coated felt set in roofing cement or hot roofing asphalt, with joints and edges sealed.
2. Complete terminations and base flashings, and provide temporary seals to prevent water from entering completed sections of roofing system.
3. Remove and discard temporary seals before beginning work on adjoining roofing.

3.7 INSTALLATION OF BASE SHEET

A. Before installing, unroll base sheet, cut into workable lengths, and allow to lie flat for a time period recommended by manufacturer for the ambient temperature.

B. Installation of SBS-Modified Bitumen Polyester and Fiberglass-Mat Base Sheet:

1. Install base sheet according to roofing manufacturer's written instructions, starting at low point of roofing system.
2. Extend roofing sheets over and terminate above cants.
3. Install base sheet in a shingle fashion.
4. Heat Weld the specified base ply to Gypsum Coverboard or Adhere Base ply to the Asphaltic coverboard with mopping of hot type IV asphalt (Encapsulation of Gypsum Coverboard with Hot Asphalt is strictly prohibited)
5. Install base sheet without wrinkles, rears, and free from air pockets.
6. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps.
    a. Lap side laps as recommended by roof membrane manufacturer but not less than 3 inches (76 mm).
    b. Lap end laps as recommended by roof membrane manufacturer but not less than 12 inches (300 mm).
    c. Stagger end laps not less than 18 inches (450 mm).
    d. Heat weld end laps, leaving no voids.
    e. Roll laps with a 20-pound (9-kg) roller.
7. Repair tears and voids in laps and lapped seams not completely sealed.
8. Apply pressure to the body of the base sheet according to manufacturer's instructions, to remove air pockets and to result in complete adhesion of base sheet to substrate.

3.8 INSTALLATION OF SBS-MODIFIED BITUMINOUS CAP SHEET

A. Before installing, unroll cap sheet, cut into workable lengths, and allow to lie flat for a time period recommended by manufacturer for the ambient temperature at which cap sheet will be installed.

B. Install modified bituminous roofing cap sheet according to roofing manufacturer's written instructions, starting at low point of roofing system.

1. Extend cap sheet over and terminate above cants.
2. Install cap sheet in a shingle fashion.
3. Install cap sheet as follows:
    a. Heat Weld Cap sheet per manufacturer requirements

4. Install cap sheet without wrinkles or tears, and free from air pockets.
5. Install cap sheet, so side and end laps shed water.

C. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps.

1. Lap side laps as recommended by roof membrane manufacturer but not less than 3 inches (76 mm).
2. Lap end laps as recommended by roof membrane manufacturer but not less than 12 inches (300 mm).
3. Stagger end laps not less than 18 inches (450 mm).
4. Heat weld laps, leaving no voids.
5. Roll laps with a 20-pound (9-kg) roller.
6. Repair tears and voids in laps and lapped seams not completely sealed.

D. Apply pressure to the body of the cap sheet according to manufacturer's instructions, to remove air pockets and to result in complete adhesion of base sheet to substrate.

E. Apply roofing granules of same color as roof membrane to cover exuded bead at laps while bead is hot, to provide a continuous color appearance.

3.9 INSTALLATION OF FLASHING AND STRIPPING

A. Install base flashing over cant strips and other sloped and vertical surfaces, at roof edges, and at penetrations through roof, and secure to substrates according to roofing system manufacturer's written instructions and as follows:

1. Prime substrates with asphalt primer if required by roofing system manufacturer.
2. Backer Sheet Application:
    a. Mechanically fasten backer sheet to walls or parapets.
    b. Adhere backer sheet over roofing membrane at cants in cold-applied adhesive.
    c. Seal all laps.
3. Backer Sheet Application:
    a. Adhere backer sheet to substrate in cold-applied adhesive.
    b. Seal all laps.

4. Flashing Sheet Application: Adhere flashing sheet to substrate in a solid mopping of hot roofing asphalt applied at asphalt temperature recommended by flashing sheet manufacturer. Apply hot roofing asphalt to back of flashing sheet if recommended by roofing system manufacturer.
5. Flashing Sheet Application: Adhere flashing sheet to substrate in cold-applied adhesive at rate required by roofing system manufacturer.
6. Flashing Sheet Application: Adhere flashing sheet to substrate in asphalt roofing cement at rate required by roofing system manufacturer.
7. Flashing Sheet Application: Torch apply flashing sheet to substrate.
    a. Perform torch application according to NFPA 241, including two-hour fire watch after torches have been extinguished.

B. Extend base flashing up walls or parapets a minimum of 8 inches (200 mm) above roofing membrane and 4 inches (100 mm) onto field of roofing membrane.

C. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.

1. Seal top termination of base flashing with a strip of glass-fiber fabric set in asphalt roofing cement.

D. Install liquid flashing system according to manufacturer's recommendations.

1. Extend liquid flashing not less than 3 inches (76 mm) in all directions from edges of item being flashed.
2. Embed granules, matching color of roof membrane, into wet compound.

E. Install roofing cap-sheet stripping where metal flanges and edgings are set on roofing according to roofing system manufacturer's written instructions.

F. Roof Drains: Set 30-by-30-inch- (760-by-760-mm-) 4-pound (1.8 kg) lead flashing in bed of asphaltic adhesive on completed roofing membrane.

1. Cover lead flashing with roofing cap-sheet stripping, and extend a minimum of 6 inches (150 mm) beyond edge of metal flashing onto field of roofing membrane.
2. Clamp roofing membrane, metal flashing, and stripping into roof-drain clamping ring.
3. Install stripping according to roofing system manufacturer's written instructions.

3.10 INSTALLATION OF WALKWAYS

A. Walkway Cap Sheet Strips: Install walkway cap sheet strips over roofing membrane, using same application method as used for roofing cap sheet.

1. Install walkways strips at the following locations:

    a. Perimeter of each rooftop unit.
    b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
    c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.

d. Top and bottom of each roof access ladder.
e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
f. Locations indicated on Drawings.
g. As required by roof membrane manufacturer's warranty requirements.

2. Provide 3-inch (76 mm) clearance between adjoining strips.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to inspect substrate conditions, surface preparation, roof membrane application, flashings, protection, and drainage components, and to furnish reports to Architect.

B. Perform the following tests:

1. Flood Testing: Flood test each roofing area for leaks, according to recommendations in ASTM D5957, after completing roofing and flashing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

a. Perform tests before overlying construction is placed.
b. Flood to an average depth of 2-1/2 inches (65 mm) with a minimum depth of 1 inch (25 mm) and not exceeding a depth of 4 inches (100 mm). Maintain 2 inches (51 mm) of clearance from top of base flashing.
c. Flood each area for 24 hours.
d. After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installations are watertight.

1) Cost of retesting is the responsibility of the Contractor.

e. Testing agency shall prepare survey report indicating locations of initial leaks, if any, and final survey report.

2. Infrared Thermography: Testing agency shall survey entire roof area using infrared color thermography according to ASTM C1153.

a. Perform tests before overlying construction is placed.
b. After infrared scan, locate specific areas of leaks by electrical capacitance/impedance testing, or by nuclear hydrogen detection testing.
c. After testing, repair leaks, repeat tests, and make further repairs until roofing and flashing installations are watertight.

1) Cost of retesting is Contractor's responsibility.

d. Testing agency shall prepare survey report of initial scan indicating locations of entrapped moisture if any.

C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.

1. Notify Architect and Owner 48 hours in advance of date and time of inspection.

D. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

E. Roofing system will be considered defective if it does not pass tests and inspections.

1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.12 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period.

1. When remaining construction does not affect or endanger roofing, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.13 ROOFING INSTALLER'S WARRANTY

A. WHEREAS _____ of _____, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: <**Insert name of Owner**>.
2. Address: <**Insert address**>.
3. Building Name/Type: <**Insert information**>.
4. Address: <**Insert address**>.
5. Area of Work: <**Insert information**>.
6. Acceptance Date: _____.
7. Warranty Period: <**Insert time**>.
8. Expiration Date: _____.

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period Roofing Installer will, at Roofing Installer's own cost and expense, make or cause to be made such repairs to or replacements of said work as are

necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:

   a. lightning;
   b. peak gust wind speed exceeding <**Insert mph (m/s)**>;
   c. fire;
   d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
   e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
   f. vapor condensation on bottom of roofing; and
   g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, _____.

1. Authorized Signature: _____.
2. Name: _____.
3. Title: _____.

END OF SECTION 075216

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Custom flashing and trim fabrications, made from the following:

1. Sheet metal materials.
2. Underlayment.
3. Miscellaneous materials.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 077200 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
3. Review requirements for insurance and certificates if applicable.
4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Shop Drawings: For sheet metal flashing and trim.

1. Plans, elevations, sections, and attachment details.
2. Fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
3. Identification of material, thickness, weight, and finish for each item and location in Project.
4. Details for forming, including profiles, shapes, seams, and dimensions.
5. Details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Details of termination points and assemblies.
7. Details of roof-penetration flashing.

8. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
9. Details of special conditions.
10. Details of connections to adjoining work.
11. Formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches (1:10).

C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.
D. Samples for Verification: Actual sample of finished products for each type of exposed finish for sheet metal and other metal accessories.

1. Sheet Metal Flashing and Trim: Manufacturers' standard size. Include finished seam with required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.
3. Multiple colors required.

E. Sustainable Design Submittals:
1. "Sustainable Design Requirements – Green Globes 2021" to validate the credits claimed to achieve Green Globes goals.
   a. Cradle-to-Gate Product Life Cycle certifications, where available.
   b. Recycled Content:, pre- and post-consumer content, where available.
   c. Sealants: Indicate VOC content.
   d. Environmental Product Declaration: For each product.

2. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)
3. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates: For each type of coping and roof edge flashing that is ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved.
B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
C. Research Reports: For copings and roof edge flashing, from ICC-ES showing compliance with ANSI/SPRI/FM 4435/ES-1.
D. Qualification Statements: For fabricator.
E. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Entity that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
B. Installer Qualifications: Entity that employs a supervisor who is an NRCA ProCertified Roofing Foreman and not less than 20 percent of installers who are NRCA ProCertified Architectural Metal Flashings and Accessories Installers.
C. For roof edge flashings and copings that are ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved, shop is to be listed as able to fabricate required details as tested and approved.

1.7 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockup of typical roof edge, including fascia trim, approximately 10 ft. (3.0 m) long, including supporting construction cleats, seams, attachments, underlayment, and accessories.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
2. Protect stored sheet metal flashing and trim from contact with water.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.9 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim are not to rattle, leak, or loosen, and are to remain watertight.
B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
C. SPRI Wind Design Standard: Manufacture and install roof edge flashings and copings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:

1. Design Pressure: As indicated on Drawings.

D. FM Approvals Listing: Manufacture and install roof edge flashings and copings that comply with requirements in FM Approvals 4471 as part of a roofing system and that are listed in FM Approvals' "Approval Guide" and approved for windstorm classification, Class 1A-120. Identify materials with name of fabricator and design approved by FM Approvals.
E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 SHEET METAL MATERIALS

A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Aluminum Sheet: Coil-coated sheet, ASTM B209/B209M, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

1. Thickness: 0.040 inch (1.02 mm).
2. Surface: Smooth, flat.
3. Exposed Coil-Coated Finish:

    a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.

4. Color: As selected by Architect from manufacturer's full range. Multiple colors required.
5. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).

C. Stainless Steel Sheet: ASTM A240/A240M, Type 304, dead soft, fully annealed.

1. Nominal Thickness: 0.0500 inch (1.270 mm).
2. Surface: Smooth, flat.
3. Exterior Finish: ASTM A480/A480M No. 4.

    a. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
    b. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

        1) Run grain of directional finishes with long dimension of each piece.
        2) When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

D. Lead Sheet: ASTM B749 lead sheet.

1. Thickness: 4 lb (1.8 kg).

2.3 UNDERLAYMENT

A. Synthetic Underlayment: Laminated or reinforced, woven polyethylene or polypropylene, synthetic roofing underlayment; bitumen free; slip resistant; suitable for high temperatures over 220 deg F (111 deg C); and complying with physical requirements of ASTM D226/D226M for Type I and Type II felts.

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. Atlas Molded Products, a division of Atlas Roofing Corporation.
    b. Intertape Polymer Group.
    c. Kirsch Building Products.
    d. SDP Advanced Polymer Products Inc.

B. Self-Adhering, High-Temperature Sheet Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils (0.76 mm) thick, specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: Stable after testing at 240 deg F (116 deg C); ASTM D1970/D1970M.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (minus 29 deg C) or lower; ASTM D1970/D1970M.
3. 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. ATAS International, Inc.
    b. Carlisle WIP Products; a brand of Carlisle Construction Materials.
    c. GCP Applied Technologies Inc.
    d. Henry Company; a Carlisle company.
    e. Owens Corning.
    f. Polyglass U.S.A., Inc.
    g. Protecto Wrap Company.
    h. SDP Advanced Polymer Products Inc.

C. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m) minimum, of type required for application.

2.4 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

    a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.

b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

2. Fasteners for Zinc-Coated (Galvanized) or Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329/F2329M.
3. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
4. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
D. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
E. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
G. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.
H. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required for application.
I. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with interlocking counterflashing on exterior face, of same metal as reglet.
1. Material: Stainless steel, 0.0188 inch (0.477 mm) thick.
2. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
3. Accessories:

a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.

2.5 FABRICATION, GENERAL

A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.

1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:

1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 ft. (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

G. Seams:
1. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

H. Do not use graphite pencils to mark metal surfaces.

2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters:

1. Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required.
2. Fabricate in minimum 96-inch- (2400-mm-) long sections.
3. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard, but with thickness not less than twice the gutter thickness.
4. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.
5. Gutter Profile: Style K in accordance with cited sheet metal standard.
6. Expansion Joints: Lap type.
7. Accessories: Wire-ball downspout strainer and Valley baffles.
8. Gutters: Fabricate from the following materials:
   a. Aluminum-Zinc Alloy-Coated Steel: 0.040 inch (1.02 mm) thick.

B. Downspouts: Fabricate rectangular downspouts to dimensions indicated on Drawings, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.

1. Fabricated Hanger Style: Fig. 1-35B in accordance with SMACNA's "Architectural Sheet Metal Manual."
2. Hanger Style: at round columns custom off-set bracket
3. Fabricate from the following materials:
   a. Aluminum-Zinc Alloy-Coated Steel: 0.040 inch (1.02 mm) thick.

C. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch- (100-mm-) wide wall flanges to interior, and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof. Fabricate from the following materials:
1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.

2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Copings: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 12 ft.- (3.6 m) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, fasten and seal watertight. Shop fabricate interior and exterior corners.

1. Coping Profile: Fig. 3-4A in accordance with SMACNA's "Architectural Sheet Metal Manual."
2. Joint Style: Butted with expansion space and 6-inch- (150-mm-) wide, concealed backup plate.
3. Fabricate from the following materials:
   a. Aluminum-Zinc Alloy-Coated Steel: 0.040 inch (1.02 mm) thick.

B. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.

C. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
1. Stainless Steel: 0.0188 inch (0.477 mm) thick.

D. Flashing Receivers: Fabricate from the following materials:
1. Stainless Steel: 0.0156 inch (0.396 mm) thick.

E. Roof-Penetration Flashing: Fabricate from the following materials:
1. Stainless Steel: 0.0188 inch (0.477 mm) thick.
2. Lead: 4 lb (1.8 kg).

F. Roof-Drain Flashing: Fabricate from the following materials:
1. Copper: 12 oz./sq. ft. (0.41 mm thick).

2.8 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

A. Valley Flashing: Fabricate from the following materials:
1. Stainless Steel: 0.0188 inch (0.477 mm) thick.

B. Drip Edges: Fabricate from the following materials:
1. Aluminum: 0.032 inch (0.81 mm) thick.

C. Eave, Rake, Ridge, and Hip Flashing: Fabricate from the following materials:
1. Aluminum: 0.032 inch (0.81 mm) thick.

D. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
1. Stainless Steel: 0.0188 inch (0.477 mm) thick.

E. Flashing Receivers: Fabricate from the following materials:
1. Stainless Steel: 0.0156 inch (0.396 mm) thick.

F. Roof-Penetration Flashing: Fabricate from the following materials:
1. Stainless Steel: 0.0188 inch (0.477 mm) thick.
2. Lead: 4 lb (1.8 kg).

2.9 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- (2400-mm-) long, but not exceeding 12 ft. (3.6 m) long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches (150 mm) beyond each side of wall openings; and form with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:

1. Stainless Steel: 0.0156 inch (0.396 mm) thick.

B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings. Form head and sill flashing with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:
1. Aluminum: 0.032 inch (0.81 mm) thick.

2.10 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:
1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.
2. Stainless Steel: 0.0188 inch (0.477 mm) thick.

B. Overhead-Piping Safety Pans: Fabricate from the following materials:

1. Galvanized Steel: 0.040 inch (1.02 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrates, and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Verify that air- or water-resistant barriers have been installed over substrate to prevent air infiltration or water penetration.

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

3.2 INSTALLATION OF UNDERLAYMENT

A. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, in accordance with manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.

1. Lap horizontal joints not less than 4 inches (100 mm).
2. Lap end joints not less than 12 inches (300 mm).

B. Self-Adhering, High-Temperature Sheet Underlayment:

1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
2. Prime substrate if recommended by underlayment manufacturer.
3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.

4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses.
5. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps and edges with roller.
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days.

C. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim.

1. Install in shingle fashion to shed water.
2. Lap joints not less than 2 inches (50 mm).

D. Install slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.

1. Install in shingle fashion to shed water.
2. Lapp joints not less than 4 inches (100 mm).

3.3 INSTALLATION OF SHEET METAL FLASHING AND TRIM, GENERAL

A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.

1. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of sealant.
3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
5. Install continuous cleats with fasteners spaced not more than 12 inches (300 mm) o.c.
6. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
7. Do not field cut sheet metal flashing and trim by torch.
8. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of uncoated-aluminum and stainless steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.

1. Space movement joints at maximum of 10 ft. (3 m) with no joints within 24 inches (600 mm) of corner or intersection.
2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
3. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated.

a. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant.
b. Form joints to completely conceal sealant.
c. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way.
d. Adjust setting proportionately for installation at higher ambient temperatures.

1) Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).

2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.

1. Pretin edges of sheets with solder to width of 1-1/2 inches (38 mm); however, reduce pretinning where pretinned surface would show in completed Work.
2. Do not solder metallic-coated steel and aluminum sheet.
3. Do not use torches for soldering.
4. Heat surfaces to receive solder, and flow solder into joint.

a. Fill joint completely.
b. Completely remove flux and spatter from exposed surfaces.

5. Stainless Steel Soldering:

a. Tin edges of uncoated sheets, using solder for stainless steel and acid flux.
b. Promptly remove acid-flux residue from metal after tinning and soldering.
c. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

3.4 INSTALLATION OF ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Hanging Gutters:

1. Join sections with joints sealed with sealant.
2. Provide for thermal expansion.
3. Attach gutters at eave or fascia to firmly anchor them in position.
4. Provide end closures and seal watertight with sealant.
5. Slope to downspouts.
6. Fasten gutter spacers to front and back of gutter.
7. Anchor and loosely lock back edge of gutter to continuous cleat.
8. Anchor gutter with gutter brackets and straps spaced not more than 24 inches (600 mm) apart to roof deck unless otherwise indicated, and loosely lock to front gutter bead.
9. Install gutter with expansion joints at locations indicated on Drawings, but not exceeding, 50 ft. (15.2 m) apart. Install expansion-joint caps.

C. Downspouts:

1. Join sections with 1-1/2-inch (38-mm) telescoping joints.
2. Provide hangers with fasteners designed to hold downspouts securely to walls.
3. Locate hangers at top and bottom and at approximately 60 inches (1500 mm) o.c.
4. Connect downspouts to underground drainage system.

D. Parapet Scuppers:

1. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
2. Anchor scupper closure trim flange to exterior wall and seal with elastomeric sealant to scupper.
3. Loosely lock front edge of scupper with conductor head.
4. Seal with elastomeric sealant exterior wall scupper flanges into back of conductor head.

3.5 INSTALLATION OF SLOPED ROOF SHEET METAL FABRICATIONS

A. Install sheet metal flashing and trim to comply with performance requirements and cited sheet metal standard.

1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing:

1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.

2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch (75-mm) centers.
3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.

C. Copings:

1. Install copings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated.

    a. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 24-inch (600-mm) centers.
    b. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch (600-mm) centers.

3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for specified FM Approvals' listing for required windstorm classification.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches (100 mm) over base flashing. Install stainless steel draw band and tighten.

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.

1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
2. Extend counterflashing 4 inches (100 mm) over base flashing.
3. Lap counterflashing joints minimum of 4 inches (100 mm).
4. Secure in waterproof manner by means of anchor and washer spaced at 12 inches (300 mm) o.c. along perimeter and 6 inches (150 mm) o.c. at corners areas unless otherwise indicated.

F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with [**elastomeric**] [**butyl**] sealant and clamp flashing to pipes that penetrate roof.

3.6 INSTALLATION OF WALL SHEET METAL FABRICATIONS

A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings.

C. Reglets: Installation of reglets is specified in Section 042000 "Unit Masonry."

3.7 INSTALLATION OF MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing:

1. Coordinate installation of equipment support flashing with installation of roofing and equipment.
2. Weld or seal flashing with elastomeric sealant to equipment support member.

B. Overhead-Piping Safety Pans:

1. Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings.
2. Pipe and install drain line to plumbing waste or drainage system.

3.8 INSTALLATION TOLERANCES

A. Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 ft. (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.9 CLEANING

A. Clean and neutralize flux materials. Clean off excess solder.
B. Clean off excess sealants.

3.10 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.
B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.
C. Maintain sheet metal flashing and trim in clean condition during construction.
D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 076200

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Manufactured units for the following applications:
   1. Roof hatches.

B. Related Requirements:

   1. Section 055000 "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof hatches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory.

   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof accessories.

   1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

C. Sustainable Design Submittals:

   1. Environmental Product Declaration: For each product.
   2. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:

   1. Size and location of roof accessories specified in this Section.
   2. Method of attaching roof accessories to roof or building structure.
   3. Required clearances.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roof accessories.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store roof accessories in contact with other materials that might cause staining, denting, or other surface damage. Store roof accessories in accordance with manufacturer's instructions.
B. Store materials off ground in dry location and in accordance with manufacturer's instructions in well-ventilated area.
C. Store and protect roof accessories from nicks, scratches, and blemishes.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify profiles and tolerances of roof-accessory substrates by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.7 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories to withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
B. Wind-Restraint Performance: As indicated on Drawings.

2.2 ROOF HATCHES

A. Metal roof-hatch units with lids and insulated single-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, stepped integral metal cant to raise the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.
B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Architectural Specialties, Inc.
2. BILCO Company (The).
3. Babcock-Davis.
4. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
5. Nystrom, Inc.

C. Type and Size:

1. Single-leaf lid, 30 by 96 inches (750 by 2438 mm).

D. Loads: Minimum 40 lbf/sq. ft. (1.9 kPa) external live load and 20 lbf/sq. ft. (0.95 kPa) internal uplift load.

E. Hatch Material, Steel: Aluminum-zinc alloy-coated steel sheet.

1. Thickness: Manufacturer's standard thickness for hatch size indicated.
2. Finish: Mill phosphatized.
3. Color: As selected by Architect from manufacturer's full range.

F. Hatch Material, Aluminum:

1. Thickness: Manufacturer's standard thickness for hatch size indicated 0.079 inch (2.01 mm).
2. Finish: Mill.
3. Color: As selected by Architect from manufacturer's full range.

G. Construction:

1. Insulation: 2-inch- (50-mm-) thick, polyisocyanurate board.

   a. R-Value: 12.0 in accordance with ASTM C1363.

2. Nailer: Factory-installed wood nailer continuous around hatch perimeter.
3. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
4. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
5. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
6. Fabricate curbs to minimum height of 12 inches (305 mm) above roofing surface unless otherwise indicated.
7. Sloping Roofs: Where slope or roof deck exceeds 1/4 inch per 12 inches (1:48), fabricate curb with perimeter curb height that is tapered to accommodate roof slope so that top surfaces of perimeter curb are level. Equip hatch with water diverter or cricket on side that obstructs water flow.

H. Hardware: Spring operators, hold-open arm, stainless steel spring latch with turn handles, stainless steel butt- or pintle-type hinge system, and padlock hasps inside and outside.

1. Provide two-point latch on lids larger than 84 inches (2130 mm).

I. Safety Railing System: Roof-hatch manufacturer's standard system, including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.

1. Height: 42 inches (1060 mm) above finished roof deck.

2. Posts and Rails: Galvanized-steel pipe, 1-1/4 inches (31 mm) in diameter or galvanized-steel tube, 1-5/8 inches (41 mm) in diameter.
3. Flat Bar: Galvanized steel, 2 inches (50 mm) high by 3/8 inch (9 mm) thick.
4. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches (533 mm) in diameter.
5. Chain Passway Barrier: Galvanized proof coil chain with quick link on fixed end.
6. Self-Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer's standard hinges and self-latching mechanism.
7. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
8. Provide weep holes or another means to drain-entrapped water in hollow sections of handrail and railing members.
9. Fabricate joints exposed to weather to be watertight.
10. Fasteners: Manufacturer's standard, finished to match railing system.
11. Finish: Manufacturer's standard.

J. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.

1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
2. Height: 42 inches (1060 mm) above finished roof deck.
3. Material: Steel tube.
4. Post: 1-5/8-inch- (41-mm-) diameter pipe.
5. Finish: Manufacturer's standard.

a. Color: As selected by Architect from manufacturer's full range.

2.3 METAL MATERIALS

A. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheer complying with minimum ASTM A653/A653M, G90 (Z275) coating designation or aluminum-zinc alloy-coated steel sheet complying with minimum ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality.

1. Mill-Phosphatized Finish: Manufacturer's standard for field painting.
2. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil (0.005 mm).
3. Powder Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils (0.05 mm).
4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil (0.013 mm).

B. Aluminum Sheet: ASTM B209/B209M, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.

1. Mill Finish: As manufactured.
2. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil (0.005 mm).
3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil (0.013 mm).

C. Aluminum Extrusions and Tubes: ASTM B221 (ASTM B221M), manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.
D. Stainless Steel Sheet and Shapes: ASTM A240/A240M or ASTM A666, Type 304.
E. Steel Shapes: ASTM A36/A36M, hot-dip galvanized in accordance with ASTM A123/A123M unless otherwise indicated.
F. Steel Tube: ASTM A500/A500M, round tube.
G. Galvanized-Steel Tube: ASTM A500/A500M, round tube, hot-dip galvanized in accordance with ASTM A123/A123M.
H. Steel Pipe: ASTM A53/A53M, galvanized.

2.4 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
B. Cellulosic-Fiber Board Insulation: ASTM C208, Type II, Grade 1, thickness as indicated.
C. Glass-Fiber Board Insulation: ASTM C726, nominal density of 3 lb/cu. ft. (48 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C), thickness as indicated.
D. Polyisocyanurate Board Insulation: ASTM C1289, thickness and thermal resistivity as indicated.
E. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches (38 mm) thick.
F. Fasteners: Roof accessory manufacturer's recommended fasteners, designed to comply with performance requirements, suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:

1. Fasteners for Metallic-Coated Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel in accordance with ASTM A153/A153M or ASTM F2329/F2329M.
2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

3. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.

G. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.
H. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.
I. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.
J. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
K. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required for application.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA AMP 500, "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
C. Verify dimensions of roof openings for roof accessories.
D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install roof accessories in accordance with manufacturer's written instructions.

1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended in writing by manufacturer's written installation instructions.

1. Coat concealed side of uncoated aluminum and stainless steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

3.3 INSTALLATION OF ROOF ACCESSORIES

A. Roof-Hatch:

1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
2. Attach safety railing system to roof-hatch curb.
3. Attach ladder-assist post in accordance with manufacturer's written instructions.

B. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

3.4 CLEANING AND PROTECTION

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing in accordance with ASTM A780/A780M.
B. Touch up factory-primed surfaces with compatible primer ready for field painting in accordance with Section 099113 "Exterior Painting."
C. On completion of installation, clean exposed surfaces in according with manufacturer's written instructions. Clean off excess sealants.
D. Remove temporary protective coverings and strippable films as roof accessories are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof accessories in a clean condition during construction.
E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 077200

SECTION 078413 - PENETRATION FIRESTOPPING

1.1 SUMMARY

A. Section Includes:

1. Penetration firestopping systems.
2. Penetrations in fire-resistance-rated walls.
3. Penetrations in horizontal assemblies.
4. Exposed penetration firestopping systems.

B. Related Requirements:

1. Section 078443 "Joint Firestopping" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.
2. Section 079200 "Joint Sealants" for non-fire-resistance-rated joint sealants.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Unlisted Firestopping Systems: Obtain an Engineering Judgment (EJ) from firestopping manufacturer where no UL, FM Approvals, or other listed assembly is available for particular firestop configuration. Follow International Firestop Council (IFC) recommended guidelines for evaluating firestopping systems in EJs.
C. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly developed in accordance with current International Firestop Council (IFC) guidelines. Obtain approval of authorities having jurisdiction prior to submittal.

D. Sustainable Design Submittals:

1. Product Data: For sealants, indicating VOC content.
2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
3. Environmental Product Declaration: For each product.
4. VOC Content for each product

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.
B. Listed System Designs: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Entity that has been approved by FM Approvals in accordance with FM Approvals 4991 or been evaluated by UL and found to comply with UL's "UL Solutions Qualified Firestop Contractor Program."
B. Manufacturer Qualifications: Entity that has received UL's "Firestop Movement Certification," which demonstrates that manufacturer's firestopping products designated with M-Ratings are based on exposure to cyclic movement and UL 1479 fire test evaluation when tested in accordance with ASTM E3037.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping systems when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
B. Install and cure penetration firestopping system materials in accordance with manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be accessed and installed in accordance with specified firestopping system design.
B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. A qualified testing agency, acceptable to authorities having jurisdiction, will perform penetration firestopping system tests.
2. Test in accordance with testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:

    a. Penetration firestopping systems installed with products bearing the classification marking of a qualified testing agency.

        1) UL in its online directory "Product iQ."
        2) Intertek Group in its "Directory of Building Products."
        3) FM Approvals in its "Approval Guide."

B. Provide components for each penetration firestopping system that, upon curing, do not re-emulsify, dissolve, leach, break down, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water, or other forms of moisture characteristic during and after construction.

C. Provide components for each penetration firestopping system that do not contain ethylene glycol.

D. Provide components for each penetration firestopping system that are sufficiently flexible to accommodate movement, such as pipe vibration, water hammer, thermal expansion, and other normal building movement without damage.

E. Provide components for each penetration firestopping system that are appropriately tested for the thickness and type of insulation utilized.

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems must be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined in accordance with ASTM E814 or UL 1479.

1. F-Rating: Not less than the fire-resistance rating of the wall penetrated.
2. Membrane Penetrations: Install recessed fixtures such that the required fire resistance will not be reduced.
3. M-Rating: Provide penetration firestopping systems meeting specified F-Rating after being tested in accordance with ASTM E3037.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined in accordance with ASTM E814 or UL 1479.

1. F-Rating: At least one hour, but not less than the fire-resistance rating of the floor penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of the floor. The following floor penetrations do not require a T-rating:

   a. Those within the cavity of a wall.
   b. Floor, tub, or shower drains within a concealed space.
   c. 4-inch (200-mm) or smaller metal conduit penetrating directly into metal-enclosed electrical switchgear.

3. W-Rating: Provide penetration firestopping systems with a Class 1 W-rating in accordance with UL 1479.
4. M-Rating: Provide penetration firestopping systems meeting specified F-Rating, T-Rating, and W-Rating after being tested in accordance with ASTM E3037.

D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested in accordance with ASTM E84 or UL 723.

1. Verify sealant has a VOC content of 250 g/L or less.
2. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify building concentration of formaldehyde does not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and acetaldehyde concentration does not exceed 9 mcg/cu. m.

2.3 ACCESSORIES

A. Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated, including but not limited to:

1. Permanent forming/damming/backing materials.
2. Substrate primers.
3. Collars.
4. Steel sleeves.

2.4 FILL MATERIALS

A. Cast-in-Place Firestopping Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
C. Firestopping Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
F. Intumescent Wrap Strips: Single-component intumescent elastomeric strips for use around combustible penetrants.
G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
H. Pillows/Bags: Compressible, removable, and reusable intumescent pillows encased in fire-retardant polyester or glass-fiber cloth. Where exposed, and when required by a listed system, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed or dislodged.
I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.
K. Thermal and Endothermic Wraps: Flexible, insulating, and fire-resistant protective wraps tested and listed for up to 2-hour fire ratings in accordance with ASTM E814 or UL 1479; for protecting membrane penetrations of utility boxes, critical electrical circuits, communications lines, and fuel lines, and for thermal barrier and circuit integrity protection in accordance with ASTM E1725 or UL 1724.
L. Fire-Rated Cable Sleeve Kits: Complete kits designed for new or existing cable penetrations through walls which accept standard accessories.
M. Fire-Rated Cable Pathways: Single or gangable device modules composed of a steel raceway with integral intumescent material and requiring no additional action in the form of plugs, twisting closure, putty, pillows, sealant, or otherwise to achieve fire and air-leakage ratings.

    1. Fire-rated cable pathway devices are the preferred product for data, video, and communications cable penetrations. Install these devices in locations where frequent cable moves, add-ons, and changes will occur. Such devices must be:

        a. Capable of retrofit around existing cables.
        b. Designed so that two or more devices can be ganged together.
        c. Maintenance-free so no action is required to activate the smoke- and fire-sealing mechanism.

2. Where fire-rated cable pathway devices are not practical, openings within walls and floors designed to accommodate data, video, and communications cabling must be provided with re-enterable products specifically designed for retrofit, such as retrofit devices for cable bundles, firestopping putty, plugs, or pillows.

N. Retrofit Device for Cable Bundles: Factory-made, intumescent, collar-like device for firestopping existing over-filled cable sleeves and capable of being installed around projecting sleeves and cable bundles.
O. Wall-Opening Protective Materials: Intumescent, non-curing putty pads or self-adhesive inserts for protection of electrical switch and receptacle boxes.
P. Fire-Rated HVAC Retaining Angles: Steel angle system with integral intumescent firestopping gasket for use around rectangular steel HVAC ducts without fire dampers.
Q. Firestopping Plugs: Flexible, re-enterable, intumescent, foam-rubber plug for use in blank round openings and cable sleeves.
R. Fire-Rated Cable Grommet: Molded two-piece grommet made of plenum-grade polymer and foam inner core for sealing small cable penetrations in gypsum walls up to 1/2 inch (13 mm) in diameter.
S. Closet Flange Gasket: Molded, single-component, flexible, intumescent gasket for use beneath a water closet (toilet) flange in floor applications.

2.5 MIXING

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings in accordance with manufacturer's written instructions and with the following requirements:

1. Remove foreign materials from substrate surfaces that could interfere with adhesion of penetration firestopping materials.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates in accordance with penetration firestopping system manufacturer's written installation instructions, using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install penetration firestopping systems in accordance with manufacturer's written installation instructions and published drawings for products and applications.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

C. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 ft. (4.57 m) from end of wall and at intervals not exceeding 30 ft. (9.14 m).

B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified inspection agency to conduct and report on inspections in accordance with ASTM E2174.
B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

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

3.7 PENETRATION FIRESTOPPING SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.
B. Where Intertek Group-listed systems are indicated, they refer to design numbers in Intertek Group's "Directory of Listed Building Products" under "Firestop Systems."

C. Where FM Approval-approved systems are indicated, they refer to design numbers listed in FM Approval's "Approval Guide" under "Wall and Floor Penetration Fire Stops."
D. Penetration Firestopping Systems with No Penetrating Items:
E. Penetration Firestopping Systems for Metallic Pipes, Conduit, or Tubing:
F. Penetration Firestopping Systems for Nonmetallic Pipe, Conduit, or Tubing:
G. Penetration Firestopping Systems for Electrical Cables:
H. Penetration Firestopping Systems for Cable Trays with Electric Cables:
I. Penetration Firestopping Systems for Insulated Pipes:
J. Penetration Firestopping Systems for Miscellaneous Electrical Penetrants:
K. Penetration Firestopping Systems for Miscellaneous Mechanical Penetrants:
L. Penetration Firestopping Systems for Groupings of Penetrants

END OF SECTION 078413

SECTION 078443 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Perimeter fire-barrier system.
2. Joints in or between fire-resistance-rated construction.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers and for wall identification.
2. Section 092216 "Non-Structural Metal Framing" for firestop tracks for metal-framed partition heads.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

B. Unlisted Firestopping Systems: Obtain an Engineering Judgment (EJ) from firestop manufacturer where no UL, FM Approvals, or other listed assembly is available for particular firestop configuration. Follow International Firestop Council (IFC) recommended guidelines for evaluating firestop systems in EJs.

C. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an EJ or equivalent fire-resistance-rated assembly developed in accordance with current IFC guidelines.

D. Sustainable Design Submittals:

1. Product Data: For sealants, indicating VOC content.
2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
3. Environmental Product Declaration: For each product.
4. VOC Content for each product

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.
B. Listed System Designs: For each joint firestopping system, for tests performed by a qualified testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written installation instructions.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Approvals in accordance with FM Approvals 4991 or been evaluated by UL and found to comply with UL's "UL Solutions Qualified Firestop Contractor Program."

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
B. Install and cure joint firestopping systems in accordance with manufacturer's written installation instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate construction of joints to ensure that joint firestopping systems can be installed in accordance with specified firestopping system design.
B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain joint firestop systems for each type of joint opening indicated from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. A qualified testing agency, acceptable to authorities having jurisdiction, will perform joint firestopping system tests.
2. Test in accordance with testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:

    a. Joint firestop systems installed with products bearing the classification marking of a qualified product certification agency in accordance with listed system designs published by a qualified testing agency.

        1) UL in its online directory "Product iQ."
        2) Intertek Group in its "Directory of Building Products."

B. Rain/Water Resistance: For perimeter fire-barrier system applications, where inclement weather or greater-than-transient water exposure is expected, use products that dry rapidly and cure in the presence of atmospheric moisture sufficient to pass ASTM D6904 early rain-resistance test (24-hour exposure).

2.3 JOINT FIRESTOPPING SYSTEM TYPES

A. General: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems must accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

1. Joint firestopping systems that are compatible with one another, with the substrates forming openings, and with penetrating items, if any.
2. Provide products that, upon curing, do not re-emulsify, dissolve, leach, break down, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture.
3. Provide firestop products that do not contain ethylene glycol.

B. Perimeter Fire-Barrier System: Provide perimeter fire-barrier system that does not require direct screw attachment to mullions and transoms to support and fasten curtain-wall insulation for aluminum curtain-wall assemblies with one- or two-piece rectangular mullions at least 2-1/2 by 5 inches (64 by 127 mm). System will be tested in accordance with ASTM E2307 for up to two-hour fire resistance and with ASTM E1233/E1233M for wind cycling equivalent to 108 mph (174 km/h) wind for 500 cycles.

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. CEMCO; California Expanded Metal Products Co.
    b. Grabber Construction Products, Inc.
    c. Specified Technologies Inc.

C. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined in accordance with ASTM E1966 or UL 2079, with published L-

Ratings for ambient and elevated temperatures as evidence of the ability of the fire-resistive joint system to restrict the movement of smoke.

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. 3M Building and Construction.
   b. Hilti, Inc.
   c. Owens Corning.
   d. ROCKWOOL.
   e. Specified Technologies Inc.
   f. Tremco Incorporated.

2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.

D. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined in accordance with ASTM E84.

1. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify building concentration of formaldehyde does not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and acetaldehyde concentration does not exceed 9 mcg/cu. m.

2.4 ACCESSORIES

A. Provide components of joint firestopping systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

A. Surface Cleaning: Before installing joint firestopping systems, clean joints in accordance with fire-resistive joint system manufacturer's written installation instructions and the following requirements:

1. Remove foreign materials from substrate surfaces that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates in accordance with joint firestopping system manufacturer's written installation instructions, using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Apply a suitable bond breaker to prevent three-sided adhesion in applications where condition occurs.

3.3 INSTALLATION

A. General: Install joint firestopping systems in accordance with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install elastomeric fill materials for joint firestopping systems by proven techniques to produce the following results:

1. Apply elastomeric fill in voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Wall Identification: Permanently label walls containing firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 ft. (4.57 m) from end of wall and at intervals not exceeding 30 ft. (9.14 m).

B. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of joint edge, so labels are visible to anyone seeking to remove joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections in accordance with ASTM E2393.
B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.
C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

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

3.7 JOINT FIRESTOPPING SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's online directory "Product iQ" under product Category XHBN or Category XHDG.

B. Where Intertek Group-listed systems are indicated, they refer to design numbers in Intertek Group's "Directory of Building Products" under product category Expansion/Seismic Joints or Firestop Systems.
C. Floor-to-Floor, Joint Firestopping Systems
D. Wall-to-Wall, Joint Firestopping Systems
E. Floor-to-Wall, Joint Firestopping Systems
F. Head-of-Wall, Fire-Resistive Joint Firestopping Systems
G. Bottom-of-Wall, Joint Firestopping Systems
H. Perimeter Joint Firestopping Systems

END OF SECTION 078443

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Immersible joint sealants.
5. Silane-modified polymer joint sealants.
6. Mildew-resistant joint sealants.
7. Polysulfide joint sealants.
8. Butyl joint sealants.
9. Latex joint sealants.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Immersible joint sealants.
5. Silane-modified polymer joint sealants.
6. Mildew-resistant joint sealants.
7. Polysulfide joint sealants.
8. Butyl joint sealants.
9. Latex joint sealants.

B. Samples for Initial Selection: Manufacturer's standard color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

E. Sustainable Design Submittals:

1. Product Data: For sealants, indicating VOC content.
2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
3. One or more of the following:
   a. Environmental Product Declaration: For each product.
   b. Third-Party Certifications: For each product.
   c. Third-Party Certified Life Cycle Assessment: For each product

1.3 INFORMATIONAL SUBMITTALS

A. Field Quality-Control Reports: For field-adhesion-test reports, for each sealant application tested.
B. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Manufacturers' special warranties.
B. Installer's special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Authorized representative who is trained and approved by manufacturer.
B. Testing Agency Qualifications: Qualified in accordance with ASTM C1021 to conduct the testing indicated.

1.6 MOCKUPS

A. Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Adhesion Testing: Use ASTM C794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

2. Compatibility Testing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket materials.
3. Stain Testing: Use ASTM C1248 to determine stain potential of sealant when in contact with stone masonry substrates.
4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
6. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
7. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.

1.8 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.9 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.

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. Adfast.
b. GE Construction Sealants; Momentive Performance Materials Inc.
c. Pecora Corporation.
d. Sika Corporation - Building Components.
e. The Dow Chemical Company.

2.3 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested in accordance with ASTM C1248.
B. Silicone, Nonstaining, S, NS, 100/50, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.

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. Adfast.
b. Pecora Corporation.
c. Sika Corporation - Building Components.
d. Tremco Incorporated.

2.4 URETHANE JOINT SEALANTS

A. Urethane, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

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. Adfast.
b. Pecora Corporation.
c. Sika Corporation - Building Components.
d. Tremco Incorporated.

2.5 IMMERSIBLE JOINT SEALANTS

A. Immersible Joint Sealants: Suitable for immersion in liquids; ASTM C1247, Class 1; tested in deionized water unless otherwise indicated.

B. Urethane, Immersible, M, NS, 50, T, NT, I: Immersible, multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 50, Uses T, NT, and I.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Tremco Incorporated.

C. Urethane, Immersible, M, NS, 25, T, NT, I: Immersible, multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 25, Uses T, NT, and I.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Master Builders Solutions; brand of MBCC Group.

D. Polysulfide, Immersible, M, NS, 25, T, NT, I: Immersible, multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, polysulfide joint sealant; ASTM C920, Type M, Grade NS, Class 25, Uses T, NT, and I.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Pecora Corporation.

2.6 SILANE-MODIFIED POLYMER JOINT SEALANTS

A. Silane-Modified Polymer, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, silyl-terminated polyether joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.

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. Adfast.
b. GE Construction Sealants; Momentive Performance Materials Inc.
c. Pecora Corporation.
d. Sika Corporation - Building Components.

2.7 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

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. Adfast.
b. Pecora Corporation.
c. Sika Corporation - Building Components.
d. The Dow Chemical Company.
e. Tremco Incorporated.

2.8 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealants: ASTM C1311.

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. Bostik; Arkema.
b. Pecora Corporation.
c. Sika Corporation - Building Components.

2.9 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

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. Adfast.
b. Pecora Corporation.
c. Sherwin-Williams Company (The).
d. Tremco Incorporated.

2.10 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

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. Adfast.
b. Alcot Plastics Ltd.
c. Construction Foam Products; a division of Nomaco, Inc.
d. Master Builders Solutions; brand of MBCC Group.

B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.11 MISCELLANEOUS MATERIALS

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

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.
    d. Exterior insulation and finish systems.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

    a. Metal.
    b. Glass.
    c. Porcelain enamel.
    d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or

by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants in accordance with requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.

3.4 CLEANING

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

3.5 PROTECTION

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

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Interior standard hollow-metal doors and frames.
   2. Exterior standard hollow-metal doors and frames.

B. Related Requirements:
   1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

1.2 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings in accordance with NAAMM-HMMA 803 or ANSI/SDI A250.8.

1.3 COORDINATION

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

1.4 ACTION SUBMITTALS

A. Product Data:
   1. Interior standard hollow-metal doors and frames.
   2. Exterior standard hollow-metal doors and frames.

B. Product Data Submittals: For each product.

   1. Include construction details, material descriptions, core descriptions, and finishes.

C. Sustainable Design Submittals:
   1. Environmental Product Declaration: For each product.
   2. Third-Party Certifications: For each product.
   3. Third-Party Certified Life Cycle Assessment: For each product.
   4. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20
   5. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)

D. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.
9. Details of moldings, removable stops, and glazing.

E. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of windborne-debris impact resistance door and thermally rated door assemblies for tests performed by a qualified testing agency indicating compliance with performance requirements.
B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.7 QUALITY ASSURANCE

A. Egress Door Inspector Qualifications: Inspector for field quality-control inspections of egress door assemblies is to meet the qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 HOLLOW METAL DOORS AND FRAMES

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. Ceco Door; AADG, Inc.; ASSA ABLOY.
2. Concept Frames, AADG, Inc.; ASSA ABLOY Group.
3. Curries, AADG, Inc.; ASSA ABLOY Group.
4. Custom Metal Products.
5. Mesker Door; Mesker Openings Group.
6. National Custom Hollow Metal Doors & Frames.
7. North American Door Corp.
8. Premier Products, Inc.
9. Republic Doors and Frames; a Allegion brand.
10. Steelcraft; Allegion plc.
11. Titan Metal Products.

2.2 PERFORMANCE REQUIREMENTS

A. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 3 for basic protection.

1. Large-Missile Test: For glazed openings located within 30 feet (9.1 m) of grade.

B. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.38 deg Btu/F x h x sq. ft. (2.16 W/K x sq. m) when tested in accordance with ASTM C1363 or ASTM E1423.

2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B..

1. Doors:

a. Type: As indicated in the Door and Frame Schedule on Drawings.
b. Thickness: 1-3/4 inches (44.5 mm).
c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch (1.0 mm).
d. Edge Construction: Model 2, Seamless.
e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
f. Core: Manufacturer's standard.
g. Insulated for sound sensitive doors as noted in door schedule.

2. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
c. Construction: Full profile welded.

3. Exposed Finish: Prime.

2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A..

1. Doors:

a. Type: As indicated in the Door and Frame Schedule on Drawings.
b. Thickness: 1-3/4 inches (44.5 mm).
c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
d. Edge Construction: Model 2, Seamless.
e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
g. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
h. Core: Manufacturer's standard.

2. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
b. Construction: Full profile welded.

3. Exposed Finish: Prime.

2.5 BORROWED LITES

A. Fabricate of metallic-coated steel sheet, minimum thickness of [**0.053 inch (1.3 mm)**] [**0.042 inch (1.0 mm)**].
B. Construction: Full profile welded.
C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.
D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.6 HOLLOW-METAL PANELS

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

2.7 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).
3. Postinstalled Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
C. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

2.8 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
D. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.
E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.
G. Glazing: Comply with requirements in Section 088000 "Glazing."

2.9 FABRICATION

A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding, or by rigid mechanical anchors.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

B. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule on Drawings, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

C. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted hairline joints.

1. Provide stops and moldings flush with face of door, and with square stops unless otherwise indicated.
2. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
3. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
4. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

2.10 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.

   a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
   b. Install frames with removable stops located on secure side of opening.
2. Floor Anchors: Secure with postinstalled expansion anchors.

a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Solidly pack mineral-fiber insulation inside frames.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
5. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.

D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

A. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Architect.
B. Inspections:
1. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.4 REPAIR

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint in accordance with manufacturer's written instructions.

C. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-core five-ply flush wood veneer-faced doors for transparent finish.
2. Light frames.

B. Related Requirements:
1. Section 064216 "Flush Wood Paneling" for requirements for veneers from the same flitches for both flush wood doors and flush wood paneling.
2. Section 088000 "Glazing" for glass view panels in flush wood doors.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Solid-core five-ply flush wood veneer-faced doors for transparent finish.
2. Light frames.

B. Product Data Submittals: For each product, including the following:

1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.
4. Door trim for openings.
5. Door frame construction.
6. Factory-machining criteria.
7. Factory- finishing specifications.

C. Sustainable Design Submittals:

1. Environmental Product Declaration: For each product.
2. Third-Party Certifications: For each product.
3. Third-Party Certified Life Cycle Assessment: For each product.
4. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
5. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20

D. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

1. Door schedule indicating door location, type, size, fire protection rating, and swing.
2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
3. Details of frame for each frame type, including dimensions and profile.
4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
5. Dimensions and locations of blocking for hardware attachment.
6. Dimensions and locations of mortises and holes for hardware.
7. Clearances and undercuts.
8. Requirements for veneer matching.
9. Doors to be factory finished and application requirements.

E. Samples for Initial Selection: For factory-finished doors.
F. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), for each material and finish. For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.
2. Frames for light openings, 6 inches (150 mm) long, for each material, type, and finish required.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.
B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Special warranties.

1.6 QUALITY ASSURANCE

A. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.
B. Package doors individually in cardboard cartons, and wrap bundles of doors in plastic sheeting.
C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.8 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install doors until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of construction period.
2. Do not deliver or install doors until building is enclosed and weathertight, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 43 and 70 percent during remainder of construction period.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Delamination of veneer.
b. Warping (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section.
c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 76.2-mm) span.

2. Warranty also includes installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 FLUSH WOOD DOORS AND FRAMES, GENERAL

A. Quality Standard: In addition to requirements specified, comply with AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Provide labels and certificates from AWI certification program indicating that doors comply with requirements of grades specified.

B. Certified Wood: Certify wood doors in accordance with the American Tree Farm System's "AFF Standard," the AF&PA's Sustainable Forestry Initiative, FSC STD-01-001 and FSC STD-40-004, or the standards of the Programme for Endorsement of Forest Certification.

2.2 SOLID-CORE FIVE-PLY FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Doors, Solid-Core Five-Ply Veneer-Faced:

1. Basis-of-Design Product: Subject to compliance with requirements, provide VT Industries or comparable product by one of the following:

   a. Masonite Architectural.
   b. Oregon Door.
   c. Oshkosh Door Company.
2. Performance Grade: ANSI/WDMA I.S. 1A Extra Heavy Duty.
3. Architectural Woodwork Standards Quality Grade: Custom.
4. Faces: Single-ply wood veneer not less than 1/50 inch (0.508 mm) thick.

   a. Species: Select white maple.
   b. Cut: Plain sliced.
   c. Match between Veneer Leaves: Book match.
   d. Assembly of Veneer Leaves on Door Faces: Running match.
   e. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
   f. Room Match:
      1) Provide door faces of compatible color and grain within each separate room or area of building.

5. Exposed Vertical and Top Edges: Same species as faces or a compatible species - Architectural Woodwork Standards edge Type A.

   a. Mineral-Core Doors: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

6. Core for Non-Fire-Rated Doors:

   a. ANSI A208.1, Grade LD-1 particleboard.

      1) Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
      2) Provide doors with glued-wood-stave cores instead of particleboard cores for doors scheduled to receive exit devices in Section 087100 "Door Hardware."

   b. Glued wood stave.

7. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.3 LIGHT FRAMES

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.

1. Wood Species: Same species as door faces.
2. Profile: Flush rectangular beads.

2.4 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated.

1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

B. Factory machine doors for hardware that is not surface applied.

1. Locate hardware to comply with DHI-WDHS-3.
2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.

C. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

2.5 FACTORY FINISHING

A. Comply with referenced quality standard for factory finishing.

1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
2. Finish faces, all four edges, edges of cutouts, and mortises.
3. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.

B. Factory finish doors.
C. Transparent Finish:

1. Architectural Woodwork Standards Grade: Premium.
   a. System-11, Polyurethane, Catalyzed.

2. Staining: Match VT Industries RAVINE

3. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

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

3.2 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."
B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 FIELD QUALITY CONTROL

A. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Architect.
1. Egress Door Inspections: Inspect each door equipped with panic hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.

B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
C. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.4 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Access doors and frames.
2. Fire-rated access doors and frames.

B. Related Requirements:

1. Section 077200 "Roof Accessories" for roof hatches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, fire ratings, material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples: For each type of access door and frame and for each finish specified, complete assembly minimum 6 by 6 inches (150 by 150 mm) in size.

C. Product Schedule: For access doors and frames.

D. Sustainable Design Submittals:

1. Environmental Product Declaration: For each product.
2. Third-Party Certifications: For each product.
3. Third-Party Certified Life Cycle Assessment: For each product.

1.3 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection and temperature-rise limit ratings indicated, according to NFPA 252 or UL 10B.

2.2 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Exposed Flanges

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Babcock-Davis.
    b. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
    c. Larsen's Manufacturing Company.
    d. Nystrom, Inc.

2. Description: Face of door flush with frame, with exposed flange and concealed hinge.
3. Locations: Wall and ceiling.
4. Door Size: As needed to access equipment.
5. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch (1.63 mm), 16 gage, factory primed.
6. Frame Material: Same material, thickness, and finish as door.
7. Latch and Lock: Cam latch, key operated.

B. Exterior Flush Access Doors:

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. Babcock-Davis.
    b. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
    c. Larsen's Manufacturing Company.
    d. Nystrom, Inc.

2. Description: Weatherproof assembly, with face of door fit flush with frame and with exposed frame. Include extruded door gaskets and minimum 2-inch- (50-mm-) thick fiberglass insulation.
3. Locations: Wall or Ceiling.
4. Door Size: As needed to access equipment.
5. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch (1.63 mm), 16 gage, factory primed.
6. Frame Material: Same material, thickness, and finish as door.
7. Latch and Lock: Cam latch operated by handle, with keyed lock in handle.

2.3 FIRE-RATED ACCESS DOORS AND FRAMES

A. Fire-Rated, Flush Access Doors with Exposed Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    a. Babcock-Davis.
    b. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
    c. Larsen's Manufacturing Company.
    d. Nystrom, Inc.
2. Description: Door face flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal; with exposed flange, self-closing door, and concealed hinge.
3. Locations: Wall and ceiling.
4. Door Size: As needed to access equipment.
5. Fire-Resistance Rating: Not less than that of adjacent construction.
6. Temperature-Rise Rating: 450 deg F (250 deg C) at the end of 30 minutes.
7. Metallic-Coated Steel Sheet for Door: Nominal 0.040 inch (1.02 mm), 20 gage, factory primed.
8. Frame Material: Same material, thickness, and finish as door.
9. Latch and Lock: Self-latching door hardware, operated by key.

2.4 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.
C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
D. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063.
E. Aluminum Sheet: ASTM B209 (ASTM B209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
F. Frame Anchors: Same material as door face.
G. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.5 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
D. Latch and Lock Hardware:

1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
2. Keys: Furnish two keys per lock and key all locks alike.

E. Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that will come in contact with concrete.

2.6 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
2. Factory Finished: Apply manufacturer's standard baked-enamel or powder-coat finish immediately after cleaning and pretreating, with minimum dry-film thickness of 1 mil (0.025 mm) for topcoat.

a. Color: As selected by Architect from full range of industry colors.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 083113

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum-framed entrance and storefront systems – Exterior impact rated.
2. Aluminum-framed entrance and storefront systems – Interior.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Aluminum-framed entrance and storefront systems.

B. Product Data Submittals: For each product.

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories.

C. Shop Drawings:

1. Plans, elevations, sections, full-size details, and attachments to other work.
2. Details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
3. Full-size isometric details of each type of vertical-to-horizontal intersection of aluminum-framed entrance and storefront systems, showing the following:

    a. Joinery, including concealed welds.
    b. Anchorage.
    c. Expansion provisions.
    d. Glazing.
    e. Flashing and drainage.

4. Connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
5. Point-to-point wiring diagrams showing the following:

    a. Power requirements for each electrically operated door hardware.

b. Location and types of switches, signal device, conduit sizes, and number and size of wires.

6. Signed and sealed by the qualified professional engineer responsible for their preparation.

D. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.

E. Samples for Verification: Actual sample of finished products for each type of exposed finish.

1. Size: Manufacturers' standard size.

F. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.
2. Anchorage.
3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

G. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

H. Delegated Design Submittals: For aluminum-framed entrances and storefront systems, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

I. Sustainable Design Documentation:
1. Environmental Product Declaration.
2. VOC Information on all products.
3. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)
4. Third-Party Certifications: For each product.
5. Third-Party Certified Life Cycle Assessment: For each product.

1.4 INFORMATIONAL SUBMITTALS

A. Energy Performance Certificates: For aluminum-framed entrance and storefront systems, accessories, and components, from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront system.

B. Product Test Reports: For aluminum-framed entrance and storefront systems, for tests performed by a qualified testing agency.

C. Source Quality-Control Reports: For aluminum-framed entrance and storefront systems.

D. Field Quality-Control Reports: For aluminum-framed entrance and storefront systems.
E. Quality-Control Program: Developed specifically for Project, including fabrication and installation, in accordance with recommendations in ASTM C1401. Include periodic quality-control reports.
F. Qualification Statements:

1. For Installer.

G. Delegated Design Engineer Qualifications: For aluminum-framed entrance and storefront systems.
H. Sample Warranties: For aluminum-framed entrance and storefront systems.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For aluminum-framed entrance and storefront systems.
B. Maintenance Data for Structural Sealant: For structural-sealant-glazed storefront. Include ASTM C1401 recommendations for post-installation-phase quality-control program.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Fabricator of products.
2. Entity that employs installers and supervisors who are trained and approved by manufacturer.
3. Authorized representative who is trained and approved by manufacturer.
4. Entity that is certified under the North American Contractor Certification Program (NACC) and that employs installers and supervisors who are trained and approved by manufacturer and who are certified under the Architectural Glass and Metal Technician (AGMT) certification program.

B. Delegated Design Engineer Qualifications: A professional engineer who is legally qualified to practice in state where Project is located and who is experienced in providing engineering services of the type indicated.
C. Testing Agency Qualifications: Qualified in accordance with ASTM E699 for testing indicated and acceptable to Owner and Architect.
D. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

E. Structural-Sealant Glazing: Comply with ASTM C1401 for design and installation of storefront systems that include structural glazing.

1.7 MOCKUPS

A. Build mockups to set quality standards for materials and execution.

1. Build mockup as indicated on Drawings.
2. Testing to be performed on mockups in accordance with requirements in "Field Quality Control" Article.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.

1.8 WARRANTY

A. Special Warranty: Manufacturer and Installer agree to repair or replace components of aluminum-framed entrance and storefront systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including but not limited to excessive deflection.
b. Faulty operation of components.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrance and storefront systems.

B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrance and storefront systems representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Aluminum-framed entrance and storefront systems to withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

    a. Thermal stresses transferring to building structure.
    b. Glass breakage.
    c. Noise or vibration created by wind and thermal and structural movements.
    d. Loosening or weakening of fasteners, attachments, and other components.
    e. Failure of operating units.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.

D. Deflection of Framing Members Supporting Glass: At design wind load, as follows:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m).
2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm).

    a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.

3. Cantilever Deflection: Limited to 2L/175 at unsupported cantilevers.

E. Structural: Test in accordance with ASTM E330/E330M as follows:

1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).

G. Water Penetration under Dynamic Pressure: Test in accordance with AAMA 501.1 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
2. Maximum Water Leakage: In accordance with AAMA 501.1 and No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.

H. Seismic Performance: Aluminum-framed entrance and storefront systems to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.

1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type when tested in accordance with AAMA 501.6 at design displacement and 1.5 times the design displacement.

I. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:

1. Thermal Transmittance (U-factor):

   a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.41 Btu/sq. ft. x h x deg F (2.33 W/sq. m x K) as determined in accordance with NFRC 100.
   b. Entrance Doors: U-factor of not more than 0.68 Btu/sq. ft. x h x deg F (3.86 W/sq. m x K) as determined in accordance with NFRC 100.

2. Solar Heat-Gain Coefficient (SHGC):

   a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.26 as determined in accordance with NFRC 200.
   b. Entrance Doors: SHGC of not more than 0.25 as determined in accordance with NFRC 200.

3. Air Leakage:

   a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa) when tested in accordance with ASTM E283.
   b. Entrance Doors: Air leakage of not more than 1.0 cfm/sq. ft. (5.08 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

4. Condensation Resistance Factor (CRF):

   a. Fixed Glazing and Framing Areas: CRF for the system of not less than 35 as determined in accordance with AAMA 1503.
   b. Entrance Doors: CRF of not less than 57 as determined in accordance with AAMA 1503.

J. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 3 for basic protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.

K. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested in accordance with AAMA 501.5.

   a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F (82 deg C).
   b. Low Exterior Ambient-Air Temperature: 0 deg F (minus 18 deg C).
   c. Interior Ambient-Air Temperature: 75 deg F (24 deg C).

L. Structural-Sealant Joints:

1. Designed to carry gravity loads of glazing.

M. Structural Sealant: ASTM C1184. Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed, aluminum-framed entrance and storefront systems without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant to occur before adhesive failure.

1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate, because sealant-to-substrate bond strength exceeds sealant's internal strength.

2.3 ALUMINUM-FRAMED ENTRANCE AND STOREFRONT SYSTEMS (EXTERIOR)

A. Basis-of-Design Product: Subject to compliance with requirements, provide EFCO System 526 IMPACT or comparable product by one of the following:

1. Kawneer Company, Inc.; Arconic Corporation.
2. YKK AP America Inc.

B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Exterior Framing Construction: Thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Center.
4. Finish: High-performance organic finish.
5. Fabrication Method: Field-fabricated stick system.
6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
7. Steel Reinforcement: As required by manufacturer.

C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

E. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.

1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch-(3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.

    a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.

2. Door Design: Wide stile; 5-inch (127-mm) nominal width.
3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.

    a. Provide nonremovable glazing stops on outside of door.

4. Finish: Match adjacent storefront framing finish.

F. Custom Aluminum Panning Systems:
1. Basis-of-Design Product: Subject to compliance with requirements, provide EFCO Custom and Standard Panning Systems or equivalent products by storefront manufacturer.

2. Extruded aluminum shapes as indicated on Drawings: Minimum aluminum thickness: 0.065 inches; Corners of aluminum panning shall be factory mitered and sealed. Panning shall match storefront framing in color and finish.

2.4 ALUMINUM-FRAMED ENTRANCE AND STOREFRONT SYSTEMS (INTERIOR)

A. Basis-of-Design Product: Subject to compliance with requirements, provide EFCO System 402 or comparable product by one of the following:

1. Kawneer Company, Inc.; Arconic Corporation.
2. YKK AP America Inc.

B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Interior Framing Construction: Nonthermal.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Center.
4. Finish: High-performance organic finish.
5. Fabrication Method: Field-fabricated stick system.
6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
7. Steel Reinforcement: As required by manufacturer.

C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

E. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.

1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch-(3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
2. Door Design: Wide stile; 5-inch (127-mm) nominal width.
3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.

a. Provide nonremovable glazing stops on outside of door.

4. Finish: Match adjacent storefront framing finish.

2.5 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."

B. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule and entrance door hardware sets indicated in "Entrance Door Hardware Sets" Article for each entrance door, to comply with requirements in this Section.

1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
3. Opening-Force Requirements:

    a. Egress Doors: Not more than 15 lbf (67 N) to release the latch and not more than 30 lbf (133 N) to set the door in motion and not more than 15 lbf (67 N) to open the door to its minimum required width.
    b. Accessible Interior Doors: Not more than 5 lbf (22.2 N) to fully open door.

C. Weather Stripping: Manufacturer's standard replaceable components.

1. Compression Type: Made of ASTM D2000 molded neoprene or ASTM D2287 molded PVC.
2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

D. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

2.6 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: As recommended by manufacturer.

1. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify building concentration of formaldehyde does not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and acetaldehyde concentration does not exceed 9 mcg/cu. m.

D. Structural Glazing Sealants: ASTM C1184 chemically curing silicone formulation that is compatible with system components with which it comes in contact; specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in storefront system indicated.

1. Color: Black.

E. Weatherseal Sealants: ASTM C920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed storefront manufacturers for this use.

1. Color: Match structural sealant.

2.7 MATERIALS

A. Sheet and Plate: ASTM B209 (ASTM B209M).
B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).
C. Structural Profiles: ASTM B308/B308M.
D. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

2.8 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.
E. Rigid PVC filler.

2.9 FABRICATION

A. Form or extrude aluminum shapes before finishing.
B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from exterior.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
E. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.
F. Storefront Framing: Fabricate components for assembly using shear-block system or screw-spline system.
G. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At interior and exterior doors, provide compression weather stripping at fixed stops.

H. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

I. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
J. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.10 ALUMINUM FINISHES

A. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.
2. Color and Gloss: "white" as selected from full range of manufacturer's standard colors and to match aluminum window.

2.11 SOURCE QUALITY CONTROL

A. Structural Sealant: Perform quality-control procedures complying with ASTM C1401 recommendations, including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE AND STOREFRONT SYSTEMS

A. Comply with manufacturer's written instructions.
B. Do not install damaged components.
C. Fit joints to produce hairline joints free of burrs and distortion.
D. Rigidly secure nonmovement joints.
E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
F. Seal perimeter and other joints watertight unless otherwise indicated.
G. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

H. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.
I. Install joint filler behind sealant as recommended by sealant manufacturer.
J. Install components plumb and true in alignment with established lines and grades.
K. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.
L. Install entrance doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware in accordance with entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

M. Install glazing as specified in Section 088000 "Glazing."
N. Install structural glazing as follows:

1. Prepare surfaces that will contact structural sealant in accordance with sealant manufacturer's written instructions, to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
2. Set glazing into framing in accordance with sealant manufacturer and framing manufacturer's written instructions and standard practice. Use a spacer or backer as recommended by manufacturer.
3. Set glazing with proper orientation so that coatings face exterior or interior as specified.
4. Hold glazing in place using temporary retainers of type and spacing recommended by manufacturer, until structural sealant joint has cured.
5. Apply structural sealant to completely fill cavity, in accordance with sealant manufacturer and framing manufacturer's written instructions and in compliance with local codes.
6. Apply structural sealant at temperatures indicated by sealant manufacturer for type of sealant.
7. Allow structural sealant to cure in accordance with manufacturer's written instructions.
8. Clean and protect glass as indicated in Section 088000 "Glazing."
9. After structural sealant has completely cured, remove temporary retainers and insert backer rod between lites of glass as recommended by sealant manufacturer.
10. Install weatherseal sealant to completely fill cavity, in accordance with sealant manufacturer's written instructions, to produce weatherproof joints.

3.3 ERECTION TOLERANCES

A. Install aluminum-framed entrance and storefront systems to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).

2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
3. Alignment:

    a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
    b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
    c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).

4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests.
B. Tests: Perform the following tests on representative areas of aluminum-framed entrance and storefront systems.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect to be tested in accordance with AAMA 501.2 and to not evidence water penetration.

    a. Perform a minimum of two tests in areas as directed by Architect.
    b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.

C. Inspection Agency: Owner will engage a qualified inspector to perform inspections.
D. Inspections:

1. Egress Door Inspections: Inspect each aluminum-framed entrance door equipped with panic hardware, located in an exit enclosure, electrically controlled, and equipped with special locking arrangements, in accordance with NFPA 101, Ch. 7 "Means of Egress," Section "Means of Egress Components," Article "Inspection of Door Openings."

E. Aluminum-framed entrance and storefront systems will be considered defective if they do not pass tests and inspections.
F. Prepare test and inspection reports.

3.5 MAINTENANCE SERVICE

A. Entrance Door Hardware Maintenance:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Use parts and supplies that are the same as those used in the manufacture and installation of original equipment.

END OF SECTION 084113

SECTION 085113 - ALUMINUM WINDOWS

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 aluminum windows for exterior locations.
B. Related Requirements:

1. Section 084113 "Aluminum-Framed Entrances and Storefronts" for coordinating finish among aluminum fenestration units.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review and discuss the finishing of aluminum windows that is required to be coordinated with the finishing of other aluminum work for color and finish matching.
3. Review, discuss, and coordinate the interrelationship of aluminum windows with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
4. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
5. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows.

B. Shop Drawings: For aluminum windows.

1. Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

C. Samples: For each exposed product and for each color specified, 2 by 4 inches (50 by 100 mm) in size.
D. Samples for Initial Selection: For units with factory-applied finishes.

1. Include Samples of hardware and accessories involving color selection.

E. Samples for Verification: For aluminum windows and components required, showing full range of color variations for finishes, and prepared on Samples of size indicated below:

1. Exposed Finishes: 2 by 4 inches (50 by 100 mm).
2. Exposed Hardware: Full-size units.

F. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.
G. Sustainable Design Documentation:
1. Environmental Product Declaration.
2. VOC Information on all products.
3. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)
4. Third-Party Certifications: For each product.
5. Third-Party Certified Life Cycle Assessment: For each product.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and Installer.
B. Product Test Reports: For each type of aluminum window, for tests performed by a qualified testing agency.
C. Field quality-control reports.
D. Sample Warranties: For manufacturer's warranties.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by test reports and calculations.
B. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.
C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of typical wall area as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure to meet performance requirements.
b. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.
c. Faulty operation of movable sash and hardware.
d. Deterioration of materials and finishes beyond normal weathering.
e. Failure of insulating glass.

2. Warranty Period:

a. Window: 10 years from date of Substantial Completion.
b. Glazing Units: 10 years from date of Substantial Completion.
c. Aluminum Finish: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain aluminum windows from single source from single manufacturer.

2.2 WINDOW PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Window Certification: AAMA certified with label attached to each window.

B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:

1. Minimum Performance Class: CW.
2. Minimum Performance Grade: 40.

C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.35 Btu/sq. ft. x h x deg F (2.0 W/sq. m x K).

D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.27.

E. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 45.

F. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F (67 deg C) ambient; 180 deg F (100 deg C) material surfaces.

G. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 3 for basic protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.

2.3 ALUMINUM WINDOWS

A. Basis-of-Design Product: Subject to compliance with requirements, provide EFCO Corporation; EFCO Series 663G Single-Hung Window (Impact) Fixed with aluminum panning or a comparable product by one of the following:

1. Kawneer Company, Inc.; Arconic Corporation.
2. YKK AP America Inc.

B. Types: Provide the following types in locations indicated on Drawings:
1. Fixed.

C. Frames and Sashes: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.

1. Thermally Improved Construction: Fabricate frames, sashes, and muntins with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.

D. Windborne-Debris-Impact-Resistant Insulating-Glass Units: ASTM E2190 with two lites and complying with impact-resistance requirements in "Window Performance Requirements" Article.

1. Exterior Lite: ASTM C1036, Type 1, Class 1, q3.

a. Tint: Clear.
b. Kind: Fully tempered.

2. Interior Lite: ASTM C1172 clear laminated glass with two plies of float glass.

a. Float Glass: Fully tempered.
b. Interlayer Thickness: 0.090 inch (2.29 mm).

3. Filling: Fill space between glass lites with air.
4. Low-E Coating: Sputtered on second surface.

E. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

1. Dual Glazing System:

a. Interior Lite: Glass.
b. Exterior Lite: Glass.

F. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.

1. Exposed Hardware Color and Finish: As selected by Architect from manufacturer's full range.

G. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.
H. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.

1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.4 ACCESSORIES

A. Integral Ventilating System/Device: Where indicated, provide weather-stripped, adjustable, horizontal fresh-air vent, with a free airflow slot, full width of window sash by approximately [**1 inch (25 mm)**] [**3 inches (75 mm)**] when open, complying with AAMA/WDMA/CSA 101/I.S.2/A440. Equip vent bar with an integral insect screen, removable for cleaning.
B. Subsills: Thermally broken, extruded-aluminum subsills in configurations indicated on Drawings.
C. Column Covers: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.
D. Interior Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.
E. Panning Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.

F. Receptor System: Two-piece, snap-together, thermally broken, extruded-aluminum receptor system that anchors windows in place.

2.5 FABRICATION

A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
B. Glaze aluminum windows in the factory.
C. Weather strip each operable sash to provide weathertight installation.
D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
E. Provide water-shed members above side-hinged sashes and similar lines of natural water penetration.
F. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.
G. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

2.6 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual" for recommendations for applying and designating finishes.
B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
B. High-Performance Organic Finish (Two-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70

percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2505 and with coating and resin manufacturers' written instructions.

1. Color and Gloss: :white as selected and approved by Architect from manufacturer's standard colors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.
C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.
D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.
B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.
C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

B. Testing Services: Testing and inspecting of installed windows shall take place as follows:

1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502.
2. Water-Resistance Testing:

    a. Test Pressure: Two-thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.
    b. Allowable Water Infiltration: No water penetration.

3. Testing Extent: Three windows of each type as selected by Architect and a qualified independent testing and inspecting agency. Windows shall be tested after perimeter sealants have cured.
4. Test Reports: Prepared according to AAMA 502.

C. Windows will be considered defective if they do not pass tests and inspections.
D. Prepare test and inspection reports.

3.4 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.
B. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

    1. Keep protective films and coverings in place until final cleaning.

C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION 085113

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware
2. Electronic access control system components

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 01 "General Requirements" sections for Allowances, Alternates, Owner Furnished Contractor Installed, Project Management and Coordination.
2. Division 06 Section "Rough Carpentry"
3. Division 06 Section "Finish Carpentry"
4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
5. Division 08 Sections:
   a. "Metal Doors and Frames"
   b. "Flush Wood Doors"
   c. "Stile and Rail Wood Doors"
   d. "Interior Aluminum Doors and Frames"
   e. "Aluminum-Framed Entrances and Storefronts"
   f. "Stainless Steel Doors and Frames"
   g. "Special Function Doors"
   h. "Entrances"
6. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
7. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.02 REFERENCES

A. UL LLC

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Keying Systems and Nomenclature
4. Installation Guide for Doors and Hardware

C. NFPA – National Fire Protection Association

1. NFPA 70 – National Electric Code
2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
3. NFPA 101 – Life Safety Code
4. NFPA 105 – Smoke and Draft Control Door Assemblies
5. NFPA 252 – Fire Tests of Door Assemblies

D. ANSI - American National Standards Institute

1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.03 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:
   a. Review drawings and Sections from related trades to verify compatibility with specified hardware.
   b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
   a. Wiring Diagrams: For power, signal, and control wiring and including:
      1) Details of interface of electrified door hardware and building safety and security systems.
      2) Schematic diagram of systems that interface with electrified door hardware.
      3) Point-to-point wiring.
      4) Risers.
3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.

a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

4. Door Hardware Schedule:
   a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
   b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
   c. Indicate complete designations of each item required for each opening, include:
      1) Door Index: door number, heading number, and Architect's hardware set number.
      2) Quantity, type, style, function, size, and finish of each hardware item.
      3) Name and manufacturer of each item.
      4) Fastenings and other pertinent information.
      5) Location of each hardware set cross-referenced to indications on Drawings.
      6) Explanation of all abbreviations, symbols, and codes contained in schedule.
      7) Mounting locations for hardware.
      8) Door and frame sizes and materials.
      9) Degree of door swing and handing.
      10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.

5. Key Schedule:
   a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
   b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
   c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
   d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
   e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
   f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

C. Informational Submittals:

1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
2. Provide Product Data:
   a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
   b. Include warranties for specified door hardware.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:

a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
b. Catalog pages for each product.
c. Final approved hardware schedule edited to reflect conditions as installed.
d. Final keying schedule
e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

E. Inspection and Testing:

1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:
   a. Fire door assemblies, in compliance with NFPA 80.
   b. Required egress door assemblies, in compliance with NFPA 101.

1.04 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
   a. For door hardware: DHI certified AHC or DHC.
   b. Can provide installation and technical data to Architect and other related subcontractors.
   c. Can inspect and verify components are in working order upon completion of installation.
   d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.

4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

1. Fire-Rated Door Openings:
   a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.

b. Provide only items of door hardware that are listed products tested by UL LLC, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

2. Smoke and Draft Control Door Assemblies:
   a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
   b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.

3. Electrified Door Hardware
   a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

4. Accessibility Requirements:
   a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

C. Pre-Installation Meetings

1. Keying Conference
   a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
      1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
      2) Preliminary key system schematic diagram.
      3) Requirements for access control.
      4) Address for delivery of keys.

2. Pre-installation Conference
   a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   b. Inspect and discuss preparatory work performed by other trades.
   c. Inspect and discuss electrical roughing-in for electrified door hardware.
   d. Review sequence of operation for each type of electrified door hardware.
   e. Review required testing, inspecting, and certifying procedures.
   f. Review questions or concerns related to proper installation and adjustment of door hardware.

3. Electrified Hardware Coordination Conference:
   a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.

C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.06 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.07 WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.

1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
    a. Mechanical Warranty
        1) Locks
            a) Schlage L Series: 3 years
            b) Schlage ND Series: 10 years
        2) Exit Devices
            a) Von Duprin: 3 years
        3) Closers
            a) LCN 4000 Series: 30 years
        4) Automatic Operators
            a) LCN: 2 years
    b. Electrical Warranty

1) Locks
   a) Schlage: 1 year
2) Exit Devices
   a) Von Duprin: 1 year
3) Closers
   a) LCN: 2 years

1.08 MAINTENANCE

A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

B. Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. The Owner requires use of certain products for their unique characteristics and project suitability to ensure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."

   1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.

B. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance with section 01 25 00.

C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.

D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

A. Fabrication

   1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer's recognized installation standards for application intended.
   2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.

3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with "Metal Doors and Frames", "Flush Wood Doors", "Stile and Rail Wood Doors" to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.

B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

C. Cable and Connectors:

1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.
3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.03 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Ives 5BB series

2. Acceptable Manufacturers and Products:
   a. Hager BB1191/1279 series
   b. McKinney TB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
   a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
   b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high

4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
   a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high

5. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
6. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
7. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
   a. Steel Hinges: Steel pins
   b. Non-Ferrous Hinges: Stainless steel pins
   c. Out-Swinging Exterior Doors: Non-removable pins
   d. Out-Swinging Interior Lockable Doors: Non-removable pins
   e. Interior Non-lockable Doors: Non-rising pins

8. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

2.04 CONTINUOUS HINGES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Select
   b. Roton
   c. ABH
   d. Hager

B. Requirements:

1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
4. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
5. On fire-rated doors, provide aluminum geared continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
6. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.05 ELECTRIC POWER TRANSFER

A. Manufacturers:

1. Scheduled Manufacturer and Product:
   a. Von Duprin EPT-10

2. Acceptable Manufacturers and Products:
   a. ABH PT1000
   b. Securitron CEPT-10
   c. Security Door Controls PTM
   d. Precision EPT-12C

B. Requirements:

1. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
2. Locate electric power transfer per manufacturer's template and UL requirements, unless interference with operation of door or other hardware items.

2.06 FLUSH BOLTS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Burns
   b. DCI
   c. Trimco
   d. Don-Jo
   e. Hager

B. Requirements:

1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.07 COORDINATORS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Burns
   b. Trimco
   c. DCI
   d. Don-Jo
   e. Hager

B. Requirements:

1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.
2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers, surface vertical rod exit device strikes, or other stop mounted hardware. Factory-prepared coordinators for vertical rod devices as specified.

2.08 MORTISE LOCKS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Best 45H series

2. Acceptable Manufacturers and Products:
   a. No substittue.

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide indicator window measuring a minimum 2-3/5-inch x 3/5 inch with 180-degree visibility. Provide messages color-coded using ANSI Z535 Safety Red with full text and/or symbols, as scheduled, for easy visibility. When applicable allows for lock status indication on both sides of the door.
3. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
4. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.
5. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide switches and sensors integrated into the locks and latches.
7. Provide motor based electrified locksets that comply with the following requirements:
   a. Universal input voltage – single chassis accepts 12 or 24VDC to allow for changes in the field without changing lock chassis.
   b. Fail Safe/Fail Secure – changing mode between electrically locked (fail safe) and electrically unlocked (fail secure) is field selectable without opening the lock case.
   c. Low maximum current draw – maximum 0.4 amps to allow for multiple locks on a single power supply.
   d. Low holding current – maximum 0.01 amps to produce minimal heat, eliminate "hot levers" in electrically locked applications, and to provide reliable operation in wood doors that provide minimal ventilation and air flow.
   e. Connections – provide quick-connect Molex system standard.

8. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.

2.09 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Best 9k Series

2. Acceptable Manufacturers and Products:
   a. No substitute.

B. Requirements:

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3-hour fire doors.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2-inch latch throw. Provide proper latch throw for UL listing at pairs.
4. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
5. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Provide electrified options as scheduled in the hardware sets.
8. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.

2.10 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Von Duprin 98/35A series

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide smooth touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
7. Provide flush end caps for exit devices.
8. Provide exit devices with manufacturer's approved strikes.
9. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
10. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
11. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
13. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
14. Provide electrified options as scheduled.
15. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.

16. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

2.11 ELECTRIC STRIKES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Von Duprin 6000 Series

2. Acceptable Manufacturers and Products:
   a. Folger Adam 300 Series
   b. HES 1006 Series

B. Requirements:

1. Provide electric strikes designed for use with type of locks shown at each opening.
2. Provide electric strikes UL Listed as burglary resistant that are tested to a minimum endurance test of 1,000,000 cycles.
3. Where required, provide electric strikes UL Listed for fire doors and frames.
4. Provide transformers and rectifiers for each strike as required. Verify voltage with electrical contractor.

2.12 POWER SUPPLIES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Schlage/Von Duprin PS900 Series

2. Acceptable Manufacturers and Products:
   a. Precision ELR series
   b. Sargent 3500 series
   c. Dynalock 5000 series
   d. Securitron BPS series
   e. Security Door Controls 600 series

B. Requirements:

1. Provide power supplies approved by manufacturer of supplied electrified hardware.
2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
3. Provide regulated and filtered 24 VDC power supply, and UL class 2 listed.
4. Provide power supplies with the following features:
   a. 12/24 VDC Output, field selectable.
   b. Class 2 Rated power limited output.
   c. Universal 120-240 VAC input.
   d. Low voltage DC, regulated and filtered.
   e. Polarized connector for distribution boards.
   f. Fused primary input.

g. AC input and DC output monitoring circuit w/LED indicators.
h. Cover mounted AC Input indication.
i. Tested and certified to meet UL294.
j. NEMA 1 enclosure.
k. Hinged cover w/lock down screws.
l. High voltage protective cover.

2.13 CYLINDERS

A. Manufacturers:

1. Scheduled Manufacturer and Product:
   a. Best

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Provide cylinders/cores to match Owner's existing key system, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.

2.14 KEYING

A. Scheduled System:

1. Existing factory registered system:
   a. Provide cylinders/cores keyed into Owner's existing factory registered keying system. Comply with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Requirements:

1. Construction Keying:
   a. Replaceable Construction Cores.
      1) Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
         a) 3 construction control keys
         b) 12 construction change (day) keys.
      2) Owner or Owner's Representative will replace temporary construction cores with permanent cores.

2. Permanent Keying:
   a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
      1) Master Keying system as directed by the Owner.
   b. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
   c. Provide keys with the following features:
      1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)

2) Patent Protection: Keys and blanks protected by one or more utility patent(s).

d. Identification:
   1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
   2) Identification stamping provisions must be approved by the Architect and Owner.
   3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
   4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
   5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.

e. Quantity: Furnish in the following quantities.
   1) Permanent Control Keys: 3.
   2) Master Keys: 6.
   3) Change (Day) Keys: 3 per cylinder/core that is keyed differently
   4) Key Blanks: Quantity as determined in the keying meeting.

2.15 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. LCN 4010/4110/4020 series

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. Certify surface mounted mechanical closers to meet fifteen million (15,000,000) full load cycles. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2-inch (38 mm) diameter with 11/16-inch (17 mm) diameter double heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers. When closers are parallel arm mounted, provide closers which mount within 6-inch (152 mm) top rail without use of mounting plate so that closer is not visible through vision panel from pull side.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI/BHMA Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).

10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.16 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. No Substitute
   b. Elmes
   c. Burns
   d. Trimco

B. Requirements:

1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

2.17 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Burns
   b. Trimco

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.18 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers:
   a. Glynn-Johnson

2. Acceptable Manufacturers:
   a. Rixson
   b. Sargent

c. ABH

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.

2.19 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Burns
   b. Trimco
   c. Rockwood

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
2. Where a wall stop cannot be used, provide universal floor stops.
3. Where wall or floor stop cannot be used, provide overhead stop.
4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.20 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Zero International

2. Acceptable Manufacturers:
   a. National Guard
   b. Reese
   c. DHSI
   d. Legacy
   e. Pemko

B. Requirements:

1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.

4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

2.21 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Burns
   b. Trimco

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.22 DOOR POSITION SWITCHES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Schlage

2. Acceptable Manufacturers:
   a. GE-Interlogix
   b. Sargent

B. Requirements:

1. Provide recessed or surface mounted type door position switches as specified.
2. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches (102 mm) between switch and magnetic locking device.

2.23 FINISHES

A. FINISH: BHMA 626/652 (US26D); EXCEPT:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
4. Protection Plates: BHMA 630 (US32D)
5. Overhead Stops and Holders: BHMA 630 (US32D)
6. Door Closers: Powder Coat to Match
7. Wall Stops: BHMA 630 (US32D)
8. Latch Protectors: BHMA 630 (US32D)
9. Weatherstripping: Clear Anodized Aluminum

10. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION

3.01 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
4. Installation Guide for Doors and Hardware: DHI TDH-007-20

B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.

C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.

D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.

I. Lock Cylinders:

1. Install construction cores to secure building and areas during construction period.
2. Furnish permanent cores to Owner for installation.

J. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:

1. Conduit, junction boxes and wire pulls.
2. Connections to and from power supplies to electrified hardware.
3. Connections to fire/smoke alarm system and smoke evacuation system.
4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Connections to panel interface modules, controllers, and gateways.
6. Testing and labeling wires with Architect's opening number.

K. Continuous Hinges: Re-locate the door and frame fire rating labels where they will remain visible so that the hinge does not cover the label once installed.

L. Door Closers & Auto Operators: Mount closers/operators on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers/operators so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

M. Overhead Stops/Holders: Mount overhead stops/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

N. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.

O. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

P. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

Q. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

R. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

S. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.03 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
2. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.04 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items per manufacturer's instructions to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.05 DOOR HARDWARE SCHEDULE

A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.

C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets:

104546 OPT0354517 Version 7

Hardware Group No. HW-01

For use on Door #(s):
101 103

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	PUSH PLATE	8200 4" X 16"		630	IVE
1	EA	HANDS FREE PULL PLATE	8322HD 8" 4" X 16"		626	IVE
1	EA	FOOT PULL	FP100		630	IVE
1	EA	SURFACE CLOSER	4111 EDA		689	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HW-01.1

For use on Door #(s):
201 202

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	PUSH PLATE	8200 4" X 16"		630	IVE
1	EA	HANDS FREE PULL PLATE	8322HD 8" 4" X 16"		626	IVE
1	EA	FOOT PULL	FP100		630	IVE
1	EA	SURFACE CLOSER	4011		689	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HW-02

For use on Door #(s):
102

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PRIVACY LOCK	45H-L-15J-VIN		626	BES
1	EA	SURFACE CLOSER	4011		689	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HW-03

For use on Door #(s):
104

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	STOREROOM LOCK	9K37D 15D		626	BES
1	EA	SURFACE CLOSER	4111 SHCUSH		689	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HW-03.1

For use on Door #(s):
206

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	STOREROOM LOCK	9K37D 15D		626	BES
1	EA	SURFACE CLOSER	4111 SHCUSH		689	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HW-05

For use on Door #(s):
105.2 107.1

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112HD		628	IVE
2	EA	PANIC HARDWARE	CD-HH-9847-EO-304L-SNB		626	VON
2	EA	MORTISE CYLINDER	1E74		626	BES
2	EA	LONG DOOR PULL	9264F 72" STD		630	IVE
2	EA	SURFACE CLOSER	4111 SCUSH		689	LCN
1	EA	WEATHER STRIPPING	BY MFR.			
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER

Hardware Group No. HW-06

For use on Door #(s):
106

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	SGL CYL DEADBOLT	8T37S STK		626	BES
1	EA	PUSH PLATE	8200 4" X 16"		630	IVE
1	EA	PULL PLATE	8302 6" 4" X 16"		630	IVE
1	EA	OH STOP	90S		630	GLY
1	EA	SURFACE CLOSER	4011		689	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HW-07

For use on Door #(s):
106.1 106A

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	CLASSROOM LOCK	9K37R 15D		626	BES
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HW-08

For use on Door #(s):
106.2

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5 NRP			630	IVE
1	EA	STOREROOM LOCK	45H-7-D-15J			626	BES
1	EA	ELECTRIC STRIKE	6210 FSE 12/16/24/28 VAC/VDC			630	VON
1	EA	SURFACE CLOSER	4111 SCUSH			689	LCN
1	EA	ARMOR PLATE	8400 36" X 1" LDW B-CS			630	IVE
1	EA	GASKETING	188SBK PSA			BK	ZER
1	EA	DOOR SWEEP	39A			A	ZER
1	EA	THRESHOLD	655A-223			A	ZER
1	EA	CREDENTIAL READER	PROVIDED BY SECURITY				
1	EA	POWER SUPPLY	PS902 120/240 VAC			LGR	SCE
1	EA	WIRING DIAGRAM	AS REQUIRED				DLR

1. THE HARDWARE SUPPLIER SHALL COORDINATE THE ELECTRIFIED HARDWARE WITH ALL RELATED TRADES.
2. DOOR FUNCTION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL AT READER WILL RELEASE ELECTRIC STRIKE AND ALLOW FOR ENTRY. DOOR ALWAYS AVAILABLE FOR FREE EGRESS.
3. CREDENTIALS, READER, AND CONNECTIONS TO THE OWNER'S NETWORK PROVIDED BY ACCESS CONTROL PROVIDER. ALL OTHER WORK PROVIDED BY ELECTRICAL CONTRACTOR.

Hardware Group No. HW-09

For use on Door #(s):
106B 208 209 210 211

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	9K37AB 15D		626	BES
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HW-10

For use on Door #(s):
105 107

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112HD		628	IVE
1	EA	PANIC HARDWARE	CDSI-98-NL		626	VON
1	EA	RIM CYLINDER	1E72		626	BES
1	EA	MORTISE CYLINDER	1E74		626	BES
1	EA	SURFACE CLOSER	4111 SCUSH		689	LCN

Hardware Group No. HW-11

For use on Door #(s):
107A 107C

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	OFFICE LOCK	9K37AB 15D		626	BES
1	EA	OH STOP	90S		630	GLY
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HW-12

For use on Door #(s):
107B

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	PRIVACY LOCK	45H-L-15J-VIN		626	BES
1	EA	SURFACE CLOSER	4111 SCUSH		689	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HW-13

For use on Door #(s):
107D 203A 207A

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	STOREROOM LOCK	9K37D 15D		626	BES
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HW-14

For use on Door #(s):
107D.1

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
1	EA	POWER TRANSFER	EPT10	✓	689	VON
1	EA	CONST LATCHING BOLT	FB51P		630	IVE
1	EA	DUST PROOF STRIKE	DP2		626	IVE
1	EA	STOREROOM LOCK	45H-7-D-15J		626	BES
1	EA	ELECTRIC STRIKE	6223 FSE DSLC 12/16/24/28 VAC/VDC	✓	630	VON
1	EA	LOCK GUARD	LG1		630	IVE
1	EA	COORDINATOR	COR X FL		628	IVE
2	EA	SURFACE CLOSER	4111 SHCUSH		689	LCN
2	EA	ARMOR PLATE	8400 36" X 1" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142AA		AA	ZER
1	EA	GASKETING	188SBK PSA		BK	ZER
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER
1	EA	CREDENTIAL READER	PROVIDED BY SECURITY	✓		
2	EA	DOOR CONTACT	679-05	✓	WHT	SCE
1	EA	POWER SUPPLY	PS902 120/240 VAC	✓	LGR	SCE
1	EA	WIRING DIAGRAM	AS REQUIRED	✓		DLR

1. THE HARDWARE SUPPLIER SHALL COORDINATE THE ELECTRIFIED HARDWARE WITH ALL RELATED TRADES.
2. DOOR FUNCTION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL AT READER WILL RELEASE ELECTRIC STRIKE AND ALLOW FOR ENTRY. DOOR ALWAYS AVAILABLE FOR FREE EGRESS.
3. CREDENTIALS, READER, AND CONNECTIONS TO THE OWNER'S NETWORK PROVIDED BY ACCESS CONTROL PROVIDER. ALL OTHER WORK PROVIDED BY ELECTRICAL CONTRACTOR.

Hardware Group No. HW-15

For use on Door #(s):
120

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP			630	IVE
1	EA	STOREROOM LOCK	45H-7-D-15J			626	BES
1	EA	SURFACE CLOSER	4111 SCUSH			689	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS			630	IVE
1	EA	RAIN DRIP	142AA			AA	ZER
1	EA	GASKETING	188SBK PSA			BK	ZER
1	EA	DOOR SWEEP	39A			A	ZER
1	EA	THRESHOLD	655A-223			A	ZER

Hardware Group No. HW-16

For use on Door #(s):
121

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP			630	IVE
1	EA	PANIC HARDWARE	LD-98-NL			626	VON
1	EA	RIM CYLINDER	1E72			626	BES
1	EA	ELECTRIC STRIKE	6111 FSE 12/24 VAC/VDC			630	VON
1	EA	SURFACE CLOSER	4111 SCUSH			689	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS			630	IVE
1	EA	RAIN DRIP	142AA			AA	ZER
1	EA	GASKETING	188SBK PSA			BK	ZER
1	EA	DOOR SWEEP	39A			A	ZER
1	EA	THRESHOLD	655A-223			A	ZER
1	EA	CREDENTIAL READER	PROVIDED BY SECURITY				
1	EA	POWER SUPPLY	PS902 120/240 VAC			LGR	SCE
1	EA	WIRING DIAGRAM	AS REQUIRED				DLR

1. THE HARDWARE SUPPLIER SHALL COORDINATE THE ELECTRIFIED HARDWARE WITH ALL RELATED TRADES.
2. DOOR FUNCTION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL AT READER WILL RELEASE ELECTRIC STRIKE AND ALLOW FOR ENTRY. DOOR ALWAYS AVAILABLE FOR FREE EGRESS.
3. CREDENTIALS, READER, AND CONNECTIONS TO THE OWNER'S NETWORK PROVIDED BY ACCESS CONTROL PROVIDER. ALL OTHER WORK PROVIDED BY ELECTRICAL CONTRACTOR.

Hardware Group No. HW-17

For use on Door #(s):
122

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5			630	IVE
1	EA	STOREROOM LOCK	45H-7-D-15J			626	BES
1	EA	ELECTRIC STRIKE	6210 FSE 12/16/24/28 VAC/VDC			630	VON
1	EA	SURFACE CLOSER	4011			689	LCN
1	EA	WALL STOP	WS406/407CCV			630	IVE
1	EA	RAIN DRIP	142AA			AA	ZER
1	EA	GASKETING	188SBK PSA			BK	ZER
1	EA	DOOR SWEEP	39A			A	ZER
1	EA	THRESHOLD	655A-223			A	ZER
1	EA	CREDENTIAL READER	PROVIDED BY SECURITY				
1	EA	POWER SUPPLY	PS902 120/240 VAC			LGR	SCE
1	EA	WIRING DIAGRAM	AS REQUIRED				DLR

1. THE HARDWARE SUPPLIER SHALL COORDINATE THE ELECTRIFIED HARDWARE WITH ALL RELATED TRADES.
2. DOOR FUNCTION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL AT READER WILL RELEASE ELECTRIC STRIKE AND ALLOW FOR ENTRY. DOOR ALWAYS AVAILABLE FOR FREE EGRESS.
3. CREDENTIALS, READER, AND CONNECTIONS TO THE OWNER'S NETWORK PROVIDED BY ACCESS CONTROL PROVIDER. ALL OTHER WORK PROVIDED BY ELECTRICAL CONTRACTOR.

Hardware Group No. HW-18

For use on Door #(s):
203.1 203.2

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP			652	IVE
1	EA	POWER TRANSFER	EPT10		✓	689	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-98-NL 24 VDC		✓	626	VON
1	EA	RIM CYLINDER	1E72			626	BES
1	EA	SURFACE CLOSER	4111 SCUSH			689	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS			630	IVE
3	EA	SILENCER	SR64/65 AS REQ			GRY	IVE
1	EA	CREDENTIAL READER	PROVIDED BY SECURITY		✓		
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC		✓	LGR	SCE
1	EA	WIRING DIAGRAM	AS REQUIRED		✓		DLR

1. THE HARDWARE SUPPLIER SHALL COORDINATE THE ELECTRIFIED HARDWARE WITH ALL RELATED TRADES.
2. DOOR FUNCTION: DOOR NORMALLY CLOSED AND LOCKED. DOOR MAY BE ELECTRICALLY DOGGED DURING BUSINESS HOURS. PRESENTING VALID CREDENTIAL AT READER WILL RETRACT LATCHBOLT AND ALLOW FOR ENTRY. DOOR ALWAYS AVAILABLE FOR FREE EGRESS. KEY OVERRIDE AVAILABLE.
3. CREDENTIALS, READER, AND CONNECTIONS TO THE OWNER'S NETWORK PROVIDED BY ACCESS CONTROL PROVIDER. ALL OTHER WORK PROVIDED BY ELECTRICAL CONTRACTOR.

Hardware Group No. HW-19

For use on Door #(s):
204 205

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	9K37D 15D			626	BES
1	EA	ELECTRIC STRIKE	6400 FSE 12/24 VAC/VDC			630	VON
1	EA	SURFACE CLOSER	4011			689	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS			630	IVE
1	EA	WALL STOP	WS406/407CCV			630	IVE
3	EA	SILENCER	SR64/65 AS REQ			GRY	IVE
1	EA	CREDENTIAL READER	PROVIDED BY SECURITY				
1	EA	POWER SUPPLY	PS902 120/240 VAC			LGR	SCE
1	EA	WIRING DIAGRAM	AS REQUIRED				DLR

1. THE HARDWARE SUPPLIER SHALL COORDINATE THE ELECTRIFIED HARDWARE WITH ALL RELATED TRADES.
2. DOOR FUNCTION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL AT READER WILL RELEASE ELECTRIC STRIKE AND ALLOW FOR ENTRY. DOOR ALWAYS AVAILABLE FOR FREE EGRESS.
3. CREDENTIALS, READER, AND CONNECTIONS TO THE OWNER'S NETWORK PROVIDED BY ACCESS CONTROL PROVIDER. ALL OTHER WORK PROVIDED BY ELECTRICAL CONTRACTOR.

Hardware Group No. HW-20

For use on Door #(s):
212

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	9K37D 15D			626	BES
1	EA	ELECTRIC STRIKE	6400 FSE 12/24 VAC/VDC			630	VON
1	EA	OH STOP	90S			630	GLY
1	EA	SURFACE CLOSER	4011			689	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS			630	IVE
3	EA	SILENCER	SR64/65 AS REQ			GRY	IVE
1	EA	CREDENTIAL READER	PROVIDED BY SECURITY				
1	EA	POWER SUPPLY	PS902 120/240 VAC			LGR	SCE
1	EA	WIRING DIAGRAM	AS REQUIRED				DLR

1. THE HARDWARE SUPPLIER SHALL COORDINATE THE ELECTRIFIED HARDWARE WITH ALL RELATED TRADES.
2. DOOR FUNCTION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL AT READER WILL RELEASE ELECTRIC STRIKE AND ALLOW FOR ENTRY. DOOR ALWAYS AVAILABLE FOR FREE EGRESS.
3. CREDENTIALS, READER, AND CONNECTIONS TO THE OWNER'S NETWORK PROVIDED BY ACCESS CONTROL PROVIDER. ALL OTHER WORK PROVIDED BY ELECTRICAL CONTRACTOR.

Hardware Group No. HW-21

For use on Door #(s):
C101.2 C201 L100.1

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
2	EA	CONT. HINGE	112HD EPT			628	IVE
2	EA	POWER TRANSFER	EPT10			689	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-HH-9847-EO-304L-SNB 24 VDC			606	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-HH-9847-NL-OP-110MD-304L-SNB 24 VDC			626	VON
1	EA	RIM CYLINDER	1E72			626	BES
2	EA	LONG DOOR PULL	9264F 72" STD			630	IVE
2	EA	SURFACE CLOSER	4111 SCUSH			689	LCN
1	EA	BOLLARD	B-6SQ-AT-32D-SM-SQ12 (AT DOOR L100.1 ONLY)				WIK
1	EA	WEATHER STRIPPING	BY MFR.				
2	EA	DOOR SWEEP	39A			A	ZER
1	EA	THRESHOLD	655A-223			A	ZER
1	EA	CREDENTIAL READER	PROVIDED BY SECURITY				
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC			LGR	SCE
1	EA	WIRING DIAGRAM	AS REQUIRED				DLR

1. THE HARDWARE SUPPLIER SHALL COORDINATE THE ELECTRIFIED HARDWARE WITH ALL RELATED TRADES.
2. DOOR FUNCTION: DOOR NORMALLY CLOSED AND LOCKED. DOOR MAY BE ELECTRICALLY DOGGED DURING BUSINESS HOURS. PRESENTING VALID CREDENTIAL AT READER WILL RETRACT LATCHBOLT AND ALLOW FOR ENTRY. DOOR ALWAYS AVAILABLE FOR FREE EGRESS. KEY OVERRIDE AVAILABLE.
3. CREDENTIALS, READER, AND CONNECTIONS TO THE OWNER'S NETWORK PROVIDED BY ACCESS CONTROL PROVIDER. ALL OTHER WORK PROVIDED BY ELECTRICAL CONTRACTOR.

Hardware Group No. HW-22

For use on Door #(s):
E103

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	9K37D 15D		626	BES
1	EA	SURFACE CLOSER	4111 SCUSH		689	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS		630	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

Hardware Group No. HW-23

For use on Door #(s):
L200

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
8	EA	HINGE	5BB1 4.5 X 4.5 NRP			652	IVE
2	EA	POWER TRANSFER	EPT10			689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-9847-EO-LBR 24 VDC			606	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-9847-NL-OP-LBR-110MD 24 VDC			626	VON
1	EA	RIM CYLINDER	1E72			626	BES
2	EA	LONG DOOR PULL	9264F 72" STD			630	IVE
2	EA	SURFACE CLOSER	4111 SCUSH			689	LCN
1	EA	CREDENTIAL READER	PROVIDED BY SECURITY				
2	EA	DOOR CONTACT	679-05			WHT	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC			LGR	SCE
1	EA	WIRING DIAGRAM	AS REQUIRED				DLR

1. THE HARDWARE SUPPLIER SHALL COORDINATE THE ELECTRIFIED HARDWARE WITH ALL RELATED TRADES.
2. DOOR FUNCTION: DOOR NORMALLY CLOSED AND LOCKED. DOOR MAY BE ELECTRICALLY DOGGED DURING BUSINESS HOURS. PRESENTING VALID CREDENTIAL AT READER WILL RETRACT LATCHBOLT AND ALLOW FOR ENTRY. DOOR ALWAYS AVAILABLE FOR FREE EGRESS. KEY OVERRIDE AVAILABLE.
3. CREDENTIALS, READER, AND CONNECTIONS TO THE OWNER'S NETWORK PROVIDED BY ACCESS CONTROL PROVIDER. ALL OTHER WORK PROVIDED BY ELECTRICAL CONTRACTOR.

Hardware Group No. HW-24

For use on Door #(s):
218

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CYLINDER	AS REQ'D TO MATCH	626	
1	EA	HARDWARE	GATE MANUFACTURER		

END OF SECTION

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass products.
2. Laminated glass.
3. Insulating glass.
4. Glazing sealants.
5. Glazing tapes.
6. Miscellaneous glazing materials.

1.2 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
B. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.
C. IBC: International Building Code.
D. Interspace: Space between lites of an insulating-glass unit.

1.3 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review temporary protection requirements for glazing during and after installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Sustainable Design Submittals:

1. Product Data: For sealants, indicating VOC content.
2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
3. Environmental Product Declaration: For each product.
4. Third-Party Certifications: For each product.
5. Third-Party Certified Life Cycle Assessment: For each product.

C. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.
1. Coated glass.
2. Laminated glass.
3. Insulating glass.

D. Glazing Accessory Samples: For sealants, in 12-inch (300-mm) lengths.
E. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
F. Delegated Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturers of fabricated glass units.
B. Product Certificates: For glass.
C. Product Test Reports: For fabricated glass and glazing sealants, for tests performed by a qualified testing agency.

1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

D. Preconstruction adhesion and compatibility test report.
E. Sample Warranties: For special warranties.

1.7 QUALITY ASSURANCE

A. Fabricated-Glass Manufacturer Qualifications: A qualified manufacturer of fabricated glass units who is approved and certified by primary glass manufacturer.

B. Installer Qualifications: A qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors and who employs glazing technicians certified under the Architectural Glass and Metal Technician (AGMT) certification program.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

E. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Install glazing in mockups specified in Section 084113 "Aluminum-Framed Entrances and Storefronts" and Section 085113 "Aluminum Windows" to match glazing systems required for Project, including glazing methods.

1.8 DELIVERY, STORAGE, AND HANDLING

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

B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F (4.4 deg C).

1.10 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

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

1. Warranty Period: Five years from date of Substantial Completion.

C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

D. Manufacturer's Special Warranty for Heat-Soaked Tempered Glass: Manufacturer agrees to replace heat-soaked tempered glass units that spontaneously break due to nickel sulfide (NiS) inclusions at a rate exceeding 0.3 percent (3/1000) within specified warranty period. Coverage for any other cause is excluded.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Glass: Obtain coated glass from single source from single manufacturer.
B. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.
C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:

1. Design Wind Pressures: As indicated on Drawings.

   a. Wind Design Data: As indicated on Drawings.
2. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.
3. Thermal Loads: Design glazing to resist thermal stress breakage induced by differential temperature conditions and limited air circulation within individual glass lites and insulated glazing units.

D. Windborne-Debris-Impact Resistance: Exterior glazing shall pass ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 3 for basic protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.

E. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

F. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
5. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW computer program.
6. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. NGA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the IGCC.
D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.

1. Minimum Glass Thickness for Exterior Lites: 6 mm.

E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

B. Ceramic-Coated Vision Glass: ASTM C1048, Condition C, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3; and complying with Specification No. 95-1-31 in NGA's "Engineering Standards Manual."
C. Reflective- and Low-E-Coated Vision Glass: ASTM C1376.

2.5 LAMINATED GLASS

A. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

B. Windborne-Debris-Impact-Resistant Laminated Glass: Comply with requirements specified above for laminated glass except laminate glass with the following to comply with interlayer manufacturer's written instructions:
1. Construction: Laminate glass with polyvinyl butyral interlayer reinforced with polyethylene terephthalate film to comply with interlayer manufacturer's written instructions.
2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

2.6 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.

1. Sealing System: Dual seal, with manufacturer's standard polyisobutylene and polyurethane primary and secondary sealants.
2. Perimeter Spacer: Manufacturer's standard spacer material and construction.
3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.7 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify building concentration of formaldehyde does not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and acetaldehyde concentration does not exceed 9 mcg/cu. m.
4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of industry colors.

2.8 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.

2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.9 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
C. Setting Blocks:

1. EPDM with Shore A durometer hardness of 85, plus or minus 5.
2. Type recommended in writing by sealant or glass manufacturer.

D. Spacers:

1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
2. Type recommended in writing by sealant or glass manufacturer.

E. Edge Blocks:

1. EPDM with Shore A durometer hardness per manufacturer's written instructions.
2. Type recommended in writing by sealant or glass manufacturer.

F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.10 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

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

3.2 PREPARATION

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

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch- (3-mm-) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

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

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
E. Do not remove release paper from tape until right before each glazing unit is installed.
F. Apply heel bead of elastomeric sealant.
G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

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

3.6 SEALANT GLAZING (WET)

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

3.7 CLEANING AND PROTECTION

A. Immediately after installation, remove nonpermanent labels and clean surfaces.
B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

    1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.
D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.8 LAMINATED GLASS SCHEDULE

A. Clear Laminated Glass Type LG-1: Two plies of fully tempered float glass.
1. Minimum Thickness of Each Glass Ply: 6 mm.
2. Interlayer Thickness: 0.060 inch (1.52 mm).
3. Safety glazing required.

B. Low-E-Coated, Laminated Vision Glass Type LG-1D: Two plies of clear heat-strengthened float glass.

1. Basis-of-Design Product: Guardian Sunguard SN54
2. Overall Unit Thickness: 9/16 inch.
3. Minimum Thickness of Each Glass Ply: 6 mm.
4. Interlayer Thickness: 0.060 inch (1.52 mm).
5. Low-E Coating: Sputtered on second surface.
6. Winter Nighttime U-Factor: 0.28 maximum.
7. Summer Daytime U-Factor: 0.27 maximum.
8. Visible Light Transmittance: 52 percent minimum.
9. SGHC: 0.28 maximum.
10. Safety glazing required.

3.9 INSULATING-LAMINATED-GLASS SCHEDULE

A. Low-E-Coated, Clear Insulating Laminated Glass Type ILG-1

1. Basis-of-Design Product: Guardian Sunguard SN54
2. Overall Unit Thickness: 1-5/16 inch.
3. Minimum Thickness of Outdoor Lite: 6 mm.
4. Outdoor Lite: Clear fully tempered float glass.
5. Interspace Content: Air.
6. Indoor Lite: Clear laminated glass with two plies of heat-strengthened float glass.
    a. Minimum Thickness of Each Glass Ply: 6 mm.
    b. Interlayer Thickness: 0.060 inch (1.52 mm).

7. Low-E Coating: Sputtered on second surface.
8. Winter Nighttime U-Factor: 0.28 maximum.
9. Summer Daytime U-Factor: 0.27 maximum.
10. Visible Light Transmittance: 52 percent minimum.
11. SGHC: 0.28 maximum.
12. Safety glazing required.

END OF SECTION 088000

SECTION 088300 - MIRRORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silvered flat glass mirrors.

B. Related Requirements:

1. Section 088000 "Glazing" for glass with reflective coatings used for vision and spandrel lites.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Mirrors: Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.

B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachment details.

C. Samples: For each type of the following:

1. Mirrors: 12 inches (300 mm) square, including edge treatment on two adjoining edges.
2. Mirror Clips: Full size.
3. Mirror Trim: 12 inches (300 mm) long.

D. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
3. Environmental Product Declaration: For each product.
4. Third-Party Certifications: For each product.
5. Third-Party Certified Life Cycle Assessment: For each product.
6. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of mirror and mirror mastic.

B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For mirrors to include in maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect mirrors in accordance with mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.
B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.

2.2 SILVERED FLAT GLASS MIRRORS

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. Avalon Glass and Mirror Company.
2. Binswanger Glass Company, Inc.; a division of Vitro Architectural Glass.
3. D & W Incorporated.

4. Donisi Mirror Company.
5. Dreamwalls by Gardner Glass Products.
6. Dulles Glass & Mirror.
7. Gardner Glass, Inc.
8. Gilded Mirrors, Inc.
9. Glasswerks LA, Inc.
10. Guardian Glass LLC.
11. Head West.
12. Independent Mirror Industries, Inc.
13. Lenoir Mirror Company.
14. National Glass Industries, Inc.
15. Stroupe Mirror Co., Inc.
16. Sunshine Mirror.
17. Trulite Glass & Aluminum Solutions, LLC.
18. Virginia Mirror Company, Inc.
19. Walker Glass Co., Ltd.

B. Mirrors, General: ASTM C1503; manufactured using copper-free, low-lead mirror coating process.

C. Annealed Monolithic Glass Mirrors: Mirror Select Quality Q1 clear.

1. Nominal Thickness: 6.0 mm.

D. Safety Glazing Products: For film-backed mirrors, provide products that comply with 16 CFR 1201, Category II.

2.3 MISCELLANEOUS MATERIALS

A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.

C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.

1. Verify adhesives have a VOC content of 70 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify building concentration of formaldehyde does not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. M, and acetaldehyde concentration does not exceed 9 mcg/cu. m.

D. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

2.4 MIRROR HARDWARE

A. Aluminum J-Channels and Cleat: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover edges of mirrors in a single piece.

1. Aluminum J-Channel and Cleat, Bottom and Side Trim: J-channels formed with front leg and back leg not less than 5/16 and 3/4 inch (7.9 and 19 mm) in height, respectively.
2. Finish: Clear bright anodized.

B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

C. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield, expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

2.5 FABRICATION

A. Shop fabricate mirrors to greatest extent possible.

B. Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts, so they fit closely around penetrations in mirrors.

C. Mirror Edge Treatment: Flat polished.

1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.
2. Require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.

D. Film-Backed Safety Mirrors: Apply film backing with adhesive coating over mirror backing paint, as recommended in writing by film-backing manufacturer, to produce a surface free of bubbles, blisters, and other imperfections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.

B. Verify compatibility with and suitability of substrates, including compatibility of existing finishes or primers with mirror mastic.

C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

3.3 INSTALLATION

A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced National Glass Association (NGA) publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
B. Provide a minimum airspace of 1/8 inch (3 mm) between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.
C. Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.
    1. Aluminum J-Channels and Cleat: Fasten J-channel directly to wall and attach top trim to continuous cleat fastened directly to wall.
    2. Mirror Clips: Place a felt or plastic pad between mirror and each clip to prevent spalling of mirror edges. Locate clips so they are symmetrically placed and evenly spaced.
    3. Install mastic as follows:

        a. Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material.
        b. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
        c. After mastic is applied, align mirrors and press into place while maintaining a minimum airspace of 1/8 inch (3 mm) between back of mirrors and mounting surface.

3.4 CLEANING AND PROTECTION

A. Protect mirrors from breakage and contaminating substances resulting from construction operations.
B. Do not permit edges of mirrors to be exposed to standing water.
C. Maintain environmental conditions that prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.

D. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Clean mirrors as recommended in writing by mirror manufacturer and NGA's publication "Proper Procedures for Cleaning Flat Glass Mirrors."

END OF SECTION 088300

SECTION 088700- WINDOW FILM

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. Architectural Window Film

B. Related Requirements:

1. Section 088000 "Glazing" for glass with reflective coatings used for vision and spandrel lites.
2. Section 088716 "Safety and Security Window Film" for safety and security window film.

1.3 REFERENCES

A. ASHRAE - American Society for Heating, Refrigeration, and Air Conditioning Engineers; Handbook of Fundamentals.

B. ASTM International (ASTM):

1. ASTM D 882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
2. ASTM D 412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers -- Tension.
3. ASTM D 624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
4. ASTM D 1004 - Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting.
5. ASTM D 1044 - Standard Method of Test for Resistance of Transparent Plastics to Surface Abrasion (Taber Abrader Test).
6. ASTM D 2240 - Standard Method for Rubber Property - Durometer Hardness.
7. ASTM D 2582 - Standard Test Method for Puncture-Propagation Tear Resistance of Plastic Film and Thin Sheeting.
8. ASTM D 5895 - Standard Test Methods for Evaluating Drying or Curing During Film Formation of Organic Coatings Using Mechanical Recorders.
9. ASTM D 4830 - Standard Test Methods for Characterizing Thermoplastic Fabrics Used in Roofing and Waterproofing.

10. ASTM E 84 - Standard Method of Test for Surface Burning Characteristics of Building Materials.
11. ASTM E 308 - Standard Recommended Practice for Spectrophotometry and Description of Color in CIE 1931 System.
12. ASTM E 903 - Standard Methods of Test for Solar Absorbance, Reflectance and Transmittance of Materials Using Integrating Spheres.
13. NFRC 100/200 (Formerly ASTM E903) - Standard Methods of Test for Solar Absorbance, Reflectance and Transmittance of Materials Using Integrating Spheres.
14. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.
15. Consumer Products Safety Commission 16 CFR, Part 1201 - Safety Standard for Architectural Glazing Materials.
16. Underwriters Laboratories Inc. (UL): UL 972 - Burglary Resisting Glazing Material.

1.4 ACTION SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

B. Samples for Initial Selection: Submit 2 sets of samples representing manufacturer's full range of colors to be selected by architect.

C. Sustainable Design Submittals:

   1. Environmental Product Declaration: For each product.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates

B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For film to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten years experience.
   1. Provide documentation that the adhesive used on the specified film is a Pressure Sensitive Adhesive (PSA)

B. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five years demonstrated experience in installing products of the same type and scope as specified.
   1. Provide documentation that the installer is authorized by the Manufacturer to perform Work specified in this section.
   2. Provide a commercial building reference list of 5 properties where the installer has applied window film. This list will include the following information:
      a. Name of building.
      b. The name and telephone number of a management contact.
      c. Type of glass.
      d. Type of film and/or film attachment system.
      e. Amount of film and/or film attachment system installed.
      f. Date of completion.
   3. Provide a Glass Stress Analysis of the existing glass and proposed glass/film combination as recommended by the film manufacturer.

C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
   1. Finish areas designated by Architect.
   2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
   3. Refinish mock-up area as required to produce acceptable work.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install film until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to replace film that deteriorate within specified warranty period.

   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   1. Acceptable Manufacturer: 3M Commercial Solutions or prior approved equal.
   2. Basis of Design: 3M Crystal Glass Finish

2.2 ARCHITECTURAL FINISH FILMS

A. Architectural Finish Films: 3M FASARA Glass Finishes Film as manufactured by 3M Company - Commercial Solutions.

B. Material Properties:
   1. General: Glass and plastic finishes field-applied application to glass or plastic material as visual opaque or decorative film.
   2. Film: Polyester.
   3. Decorative Pattern: Printed.
   4. Adhesive: Acrylic, Pressure Sensitive, Permanent.
   5. Liner: Silicone-coated Polyester.
   6. Thickness (Average): 3.2 mils (80 microns).
   7. Fire Performance: Surface burning characteristics when tested in accordance with ASTM E84: Class A:
      a. Flame Spread: 25 maximum.
      b. Smoke Developed: 450 maximum.

C. Optical Performance: Border/Horizontal Series.
   1. Crystal Glass Finishes Frosted Crystal Decorative / Privacy Glazing Film applied to 3mm thick clear glass (ASTM E 903, ASTM E 308):
      a. Ultraviolet Transmittance: 0.1 percent.
      b. Visible Light Transmittance: 50 percent.
      c. Visible Light Reflectance - Interior: 20 percent.
      d. Solar Heat Transmittance: 53 percent.
      e. Solar Heat Reflectance: 17 percent.
      f. Shading Coefficient at 90 Degrees (Normal Incidence): 0.71.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Film Examination:
   1. If preparation of glass surfaces is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.
   2. Glass surfaces receiving new film should first be examined to verify that they are free from defects and imperfections, which will affect the final appearance.
   3. Do not proceed with installation until glass surfaces have been properly prepared and deviations from manufacturer's recommended tolerances are corrected. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result under the project conditions.
   4. Commencement of installation constitutes acceptance of conditions.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Refer to Manufacturer's installation instructions for methods of preparation for Impact Protection Adhesive or Impact Protection Profile film attachment systems.

3.3 INSTALLATION

A. Film Installation:
   1. Install in accordance with manufacturer's instructions.
   2. Cut film edges neatly and square at a uniform distance of 1/8 inch (3 mm) to 1/16 inch (1.5 mm) of window sealant. Use new blade tips after 3 to 4 cuts.
   3. Spray the slip solution, composed of one capful of baby shampoo or dishwashing liquid to 1 gallon of water, on window glass and adhesive to facilitate proper positioning of film.
   4. Apply film to glass and lightly spray film with slip solution.
   5. Squeegee from top to bottom of window. Spray slip solution to film and squeegee a second time.
   6. Bump film edge with lint-free towel wrapped around edge of a 5-way tool.
   7. Upon completion of film application, allow 30 days for moisture from film installation to dry thoroughly, and to allow film to dry flat with no moisture dimples when viewed under normal viewing conditions.

3.4 CLEANING AND PROTECTION

A. Remove left over material and debris from Work area. Use necessary means to protect film before, during, and after installation.
B. Touch-up, repair or replace damaged products before Substantial Completion.
C. After application of film, wash film using common window cleaning solutions, including ammonia solutions, 30 days after application. Do not use abrasive type cleaning agents and bristle brushes to avoid scratching film. Use synthetic sponges or soft cloths.

END OF SECTION 088700

SECTION 089119 - FIXED LOUVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fixed extruded-aluminum louvers.

1.2 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
B. Horizontal Louver: Louver with horizontal blades (i.e., the axis of the blades are horizontal).
C. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.
D. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven-rain performance, as determined by testing in accordance with AMCA 500-L.
E. Windborne-Debris-Impact-Resistant Louver: Louver that provides specified windborne-debris-impact resistance, as determined by testing in accordance with AMCA 540.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Sustainable Design Submittals:
1. Environmental Product Declaration: For each product.
2. Third-Party Certifications: For each product.
3. Third-Party Certified Life Cycle Assessment: For each product.
4. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)

C. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashings, sealants, and other means of preventing water intrusion.

2. Show mullion profiles and locations.

D. Samples: For each type of metal finish required.
E. Delegated Design Submittal: For louvers indicated to comply with structural and seismic performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed in accordance with AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.
B. Windborne-debris-impact-resistance test reports.
C. Sample Warranties: For manufacturer's special warranties.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.6 FIELD CONDITIONS

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

1.7 WARRANTY

A. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain fixed louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural and seismic performance requirements and design criteria indicated.

B. Structural Performance: Louvers withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures are considered to act normal to the face of the building.

1. Wind Loads:

a. Determine loads based on pressures as indicated on Drawings.

C. Windborne-Debris-Impact Resistance: Louvers located within 30 feet (9.1 m) of grade pass basic protection, when tested in accordance with AMCA 540.

D. Seismic Performance:

1. As indicated on Drawings.

E. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width in accordance with AMCA 500-L.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

G. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.3 FIXED EXTRUDED-ALUMINUM LOUVERS

A. Horizontal, Drainable-Blade, Windborne-Debris-Impact-Resistant Louver, Extruded Aluminum:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Airolite Company, LLC (The); K6744X or a comparable product by one of the following:

   a. Aire Technologies, Inc.; DMI Companies.
   b. Greenheck Fan Corporation.
   c. Reliable Products, Inc.

2. Louver Depth: 4 inches (100 mm).
3. Frame and Blade Nominal Thickness: Not less than 0.080 inch (2.03 mm).
4. Mullion Type: Exposed.
5. Louver Performance Ratings:

   a. Free Area: Not less than 9.0 sq. ft. (0.84 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
   b. Point of Beginning Water Penetration: Not less than 1077 fpm (5.5 m/s).
   c. Air Performance:

      1) Not more than 0.16-inch wg (40-Pa) static pressure drop at 989-fpm (5.0-m/s) free-area exhaust /intake velocity.

6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
7. AMCA Rating: AMCA 540.

2.4 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

   1. Screen Location for Fixed Louvers: Interior face.
   2. Screening Type: Bird screening.

B. Secure screen frames to louver frames with stainless steel machine screws, spaced a maximum of 6 inches (150 mm) from each corner and at 12 inches (300 mm) o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

   1. Metal: Same type and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
   2. Finish: Same finish as louver frames to which louver screens are attached.
   3. Type: Rewirable frames with a driven spline or insert.

D. Louver Screening for Aluminum Louvers:

   1. Bird Screening, Aluminum: 1/2-inch- (13-mm-) square mesh, 0.063-inch (1.60-mm) wire.

2.5 MATERIALS

A. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B209 (ASTM B209M), 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 A653/A653M, G60 (Z180) zinc coating, mill phosphatized.
D. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
2. For fastening aluminum, use aluminum or 300 series stainless steel fasteners.
3. For fastening galvanized steel, use hot-dip-galvanized-steel or 300 series stainless steel fasteners.
4. For fastening stainless steel, use 300 series stainless steel fasteners.
5. For color-finished louvers, use fasteners with heads that match color of louvers.

E. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, fabricated from stainless steel components, with allowable load or strength design capacities calculated in accordance with ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing in accordance with ASTM E488/E488M conducted by a qualified testing agency.
F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
G. Recycled Content of Aluminum Components: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.

2.6 FABRICATION

A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

1. Frame Type: Channel unless otherwise indicated.

D. Include supports, anchorages, and accessories required for complete assembly.
E. Provide subsills made of same material as louvers or extended sills for recessed louvers.
F. Join frame members to each other and to fixed louver blades with fillet welds concealed from view unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.7 ALUMINUM FINISHES

A. Finish louvers after assembly.
B. Superior-Performance Organic Finish, Three-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.
2. Color and Gloss: Match Architect's sample – charcoal gray.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.
B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
C. Form closely fitted joints with exposed connections accurately located and secured.
D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
E. Protect unpainted galvanized- and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
C. Restore louvers damaged during installation and construction, so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

    1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 089119

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Framing systems.
2. Suspension systems.
3. Grid suspension systems.

B. Related Requirements:

1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; and roof rafters and ceiling joists.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Framing systems.
2. Suspension systems.
3. Grid suspension systems.

B. Sustainable Design Submittals:

1. "Sustainable Design Requirements – Green Globes 2021" to validate the credits claimed to achieve Green Globes goals.
   a. Cradle-to-Gate Product Life Cycle certifications, where available.
   b. Recycled Content:, pre- and post-consumer content, where available.
   c. Sealants: Indicate VOC content.
   d. Environmental Product Declaration: For each product.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of code-compliance certification for studs and tracks.
B. Evaluation Reports: For firestop tracks, post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.4 QUALITY ASSURANCE

A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud

Association, the Steel Framing Industry, Association the Steel Stud, Manufacturers Association or the Supreme Steel Framing System Association.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Notify manufacturer of damaged materials received prior to installation.
B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
C. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, in accordance with ASTM E119 by an independent testing agency.
B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.
C. Horizontal Deflection: For non-composite wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft. (239 Pa).
D. Design framing systems in accordance with AISI S220, "North American Specification for the Design of Cold-Formed Steel Framing - Nonstructural Members," unless otherwise indicated.
E. Design Loads: As indicated on architectural Drawings or 5 lbf/sq. ft. (239 Pa) minimum as required by the IBC.
F. Design framing systems to accommodate deflection of primary building structure and construction tolerances and to withstand design loads with a maximum deflection of <**Insert inches (mm)**>.

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with AISI S220 for conditions indicated.

1. Steel Sheet Components: Comply with AISI S220 requirements for metal unless otherwise indicated
2. Protective Coating: Comply with AISI S220; ASTM A653/A653M, G40 (Z120); or coating with equivalent corrosion resistance. Galvannealed products are unacceptable.

a. Coating demonstrates equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.

B. Studs and Track: AISI S220.

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. CEMCO; California Expanded Metal Products Co.
b. ClarkDietrich.
c. Marino\WARE.
d. SCAFCO Steel Stud Company; Stone Group of Companies.
e. Steel Construction Systems; Stone Group of Companies.
f. Steel Network, Inc. (The).

2. Minimum Base-Steel Thickness: As required by performance requirements for horizontal deflection 0.0329 inch (0.836 mm).
3. Depth: As indicated on Drawings.

C. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Single Long-Leg Track System: Top track with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
2. Double-Track System: Top outer tracks, inside track with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
3. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

D. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Steel Thickness: 0.0329 inch (0.836 mm).

F. Cold-Rolled Channel Bridging: Steel, 0.0538-inch (1.367-mm) minimum base-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: 1-1/2 inches (38 mm).
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.

G. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: 3/4 inch (19 mm).
2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch (0.8 mm).
3. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

H. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 3/4 inch (19 mm), minimum uncoated-steel thickness of 0.0179 inch (0.455 mm), and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
B. Hanger Attachments to Concrete:

1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC58 or AC308 as appropriate for the substrate.

   a. Uses: Securing hangers to structure.
   b. Type: Torque-controlled, expansion anchor, torque-controlled, adhesive anchor or adhesive anchor.
   c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
   d. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 (A4) stainless steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

2. Power-Actuated Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

C. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.
D. Flat Hangers: Steel sheet, 1 by 3/16 inch (25 by 5 mm) by length indicated.
E. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch (1.367 mm) and minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: 2-1/2 inches (64 mm).

F. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.0538-inch (1.367-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
2. Steel Studs and Tracks:

a. Minimum Base-Steel Thickness: 0.0329 inch (0.836 mm).
b. Depth: 1-5/8 inches (41 mm).

2.4 GRID SUSPENSION SYSTEMS

A. Grid Suspension Systems for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.

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. Armstrong Ceiling & Wall Solutions.
b. CertainTeed; SAINT-GOBAIN.
c. Rockfon; ROCKWOOL International.
d. USG Corporation.

2.5 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building

structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

B. Coordination with Sprayed Fire-Resistive Materials:

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches (610 mm) o.c.
2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C754.
1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
D. Install bracing at terminations in assemblies.
E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLATION OF FRAMING SYSTEMS

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
2. Multilayer Application: 16 inches (406 mm) o.c. unless otherwise indicated.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
C. Install studs so flanges within framing system point in same direction.

D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb unless otherwise indicated.
    b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
    c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

    a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

E. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.5 INSTALLATION OF SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Hangers: 48 inches (1219 mm) o.c.
2. Carrying Channels (Main Runners): 48 inches (1219 mm) o.c.
3. Furring Channels (Furring Members): 16 inches (406 mm) o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

    a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

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

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

3.6 INSTALLATION OF GRID SUSPENSION SYSTEMS

A. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

3.7 FIELD QUALITY CONTROL

A. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092400 - CEMENT PLASTERING

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 vertical plasterwork.

1.3 PREINSTALLATION MEETINGS

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.
C. Samples: For each type of factory-prepared finish coat and for each color and texture specified.
D. Samples for Initial Selection: For each type of factory-prepared finish coat and for each color and texture specified.
E. Sustainable Design Submittals:

   1. Environmental Product Declaration: For each product.
   2. VOC Content for each product.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials inside under cover, and keep them dry and protected against damage from weather, moisture, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

1.6 FIELD CONDITIONS

A. Comply with ASTM C926 requirements.

B. Interior Plasterwork: Maintain room temperatures at greater than 40 deg F (4.4 deg C) for at least 48 hours before plaster application, and continuously during and after application.

1. Avoid conditions that result in plaster drying out during curing period. Distribute heat evenly; prevent concentrated or uneven heat on plaster.
2. Ventilate building spaces as required to remove water in excess of that required for hydrating plaster in a manner that prevents drafts of air from contacting surfaces during plaster application and until plaster is dry.

C. Factory-Prepared Finishes: Comply with manufacturer's written recommendations for environmental conditions for applying finishes.

PART 2 - PRODUCTS

2.1 ACCESSORIES

A. General: Comply with ASTM C1063, and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.
B. Metal Accessories:

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. CEMCO; California Expanded Metal Products Co.
b. ClarkDietrich.
c. Phillips Manufacturing Co.

2. Cornerbeads: Fabricated from zinc.

a. Smallnose cornerbead with expanded flanges; use unless otherwise indicated.
b. Smallnose cornerbead with expanded flanges reinforced by perforated stiffening rib; use on columns and for finishing unit masonry corners.
c. Bullnose cornerbead, radius 3/4 inch (19 mm) minimum, with expanded flanges; use at locations indicated on Drawings.

3. Control Joints: Fabricated from zinc; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.

2.2 MISCELLANEOUS MATERIALS

A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.
B. Bonding Compound: ASTM C932.

2.3 PLASTER MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I.

1. Color for Finish Coats: White.

B. Masonry Cement: ASTM C91, Type N.

1. Color for Finish Coats: White.

C. Lime: ASTM C206, Type S; or ASTM C207, Type S.
D. Sand Aggregate: ASTM C897.
E. Acrylic-Based Finish Coatings: Factory-mixed acrylic-emulsion coating systems formulated with colorfast mineral pigments and fine aggregates; for use over cement plaster base coats. Include manufacturer's recommended primers and sealing topcoats for acrylic-based finishes.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Senergy; BASF Corp.; Alpha Genie Base Coat or a comparable product by one of the following:

a. Dryvit Systems, Inc.

2.4 PLASTER MIXES

A. General: Comply with ASTM C926 for applications indicated.

1. Fiber Content: Add fiber to base-coat mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed 1 lb of fiber/cu. yd. (0.6 kg of fiber/cu. m) of cementitious materials.

B. Base-Coat Mixes for Use over Unit Masonry: Single base (scratch) coat for two-coat plasterwork on high-absorption plaster bases as follows:

1. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.

C. Factory-Prepared Finish-Coat Mixes: For acrylic-based finish coatings, comply with manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.
B. Prepare smooth, solid substrates for plaster according to ASTM C926.

3.3 INSTALLING ACCESSORIES

A. Install according to ASTM C1063 and at locations indicated on Drawings.
B. Reinforcement for External (Outside) Corners:
   1. Install cornerbead at interior locations.

C. Control Joints: Locate as approved by Architect for visual effect and as follows:

   1. As required to delineate plasterwork into areas (panels) of the following maximum sizes:

      a. Vertical Surfaces: 144 sq. ft. (13.4 sq. m).

   2. At distances between control joints of not greater than 18 feet (5.5 m) o.c.
   3. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.
   4. Where control joints occur in surface of construction directly behind plaster.
   5. Where plasterwork areas change dimensions, to delineate rectangular-shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.

3.4 PLASTER APPLICATION

A. General: Comply with ASTM C926.

   1. Do not deviate more than plus or minus 1/4 inch in 10 feet (6 mm in 3 m) from a true plane in finished plaster surfaces when measured by a 10-foot (3-m) straightedge placed on surface.
   2. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.
   3. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

B. Bonding Compound: Apply on unit masonry substrates for direct application of plaster.
C. Walls; Base-Coat Mix: For base (scratch) coat, for two-coat plasterwork and having 3/8-inch (10-mm) thickness on masonry, as follows:

   1. Portland cement mix.

D. Acrylic-Based Finish Coatings: Apply coating system, including primers, finish coats, and sealing topcoats, according to manufacturer's written instructions.
E. Concealed Exterior Plasterwork: Where plaster application is used as a base for adhered finishes, omit finish coat.
F. Concealed Interior Plasterwork:

1. Where plaster application is concealed behind built-in cabinets, similar furnishings, and equipment, apply finish coat.
2. Where plaster application is concealed above suspended ceilings and in similar locations, omit finish coat.

3.5 PLASTER REPAIRS

A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, effloresence, sweat outs, and similar defects and where bond to substrate has failed.

3.6 CLEANING AND PROTECTION

A. Remove temporary protection and enclosure of other work after plastering is complete. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

END OF SECTION 092400

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.

B. Related Requirements:

1. Section 061600 "Sheathing" for gypsum sheathing for exterior walls and ceilings.
2. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.
3. Section 093013 "Ceramic Tiling" for cementitious backer units installed as substrates for ceramic tile.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Gypsum wallboard.
2. Gypsum board, Type X.
3. Gypsum ceiling board.
4. Abuse-resistant gypsum board.
5. Mold-resistant gypsum board.
6. Gypsum board, Type C.
7. Interior trim.
8. Aluminum trim.
9. Joint treatment materials.
10. Laminating adhesive.
11. Sound-attenuation blankets.
12. Acoustical sealant.

B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.

C. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

D. Sustainable Design Submittals:

1. Product Data: For adhesives and sealants, indicating VOC content.

2. Laboratory Test Reports: For adhesives and sealants, indicating compliance with requirements for low-emitting materials.
3. Environmental Product Declaration.
4. Third-Party Certifications: For each product.
5. Third-Party Certified Life Cycle Assessment: For each product.
6. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20
7. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)

1.3 DELIVERY, STORAGE AND HANDLING

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

1.4 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
C. Do not install panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of gypsum panel and joint finishing material from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with ASTM E119 by an independent testing agency.
B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.

2.3 GYPSUM BOARD, GENERAL

A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.
B. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.4 INTERIOR GYPSUM BOARD

A. Gypsum Board, Type X: ASTM C1396/C1396M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. American Gypsum.
   b. CertainTeed; SAINT-GOBAIN.
   c. Georgia-Pacific Gypsum LLC.
   d. Gold Bond Building Products, LLC provided by National Gypsum Company.
   e. PABCO Gypsum.
   f. Panel Rey.
   g. USG Corporation.

2. Thickness: 5/8 inch (15.9 mm).
3. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

B. Gypsum Ceiling Board: ASTM C1396/C1396M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Gypsum.
   b. CertainTeed; SAINT-GOBAIN.
   c. Georgia-Pacific Gypsum LLC.
   d. Gold Bond Building Products, LLC provided by National Gypsum Company.
   e. PABCO Gypsum.
   f. Panel Rey.

2. Thickness: 1/2 inch (12.7 mm).
3. Long Edges: Tapered.

C. Abuse-Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested in accordance with ASTM C1629/C1629M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. American Gypsum.
b. CertainTeed; SAINT-GOBAIN.
c. Georgia-Pacific Gypsum LLC.
d. Gold Bond Building Products, LLC provided by National Gypsum Company.
e. PABCO Gypsum.
f. USG Corporation.

2. Core: 5/8 inch (15.9 mm), Type X.
3. Surface Abrasion: ASTM C1629/C1629M, meets or exceeds Level 1 requirements.
4. Indentation: ASTM C1629/C1629M, meets or exceeds Level 1 requirements.
5. Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 1 requirements.
6. Long Edges: Tapered.
7. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

D. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. American Gypsum.
b. CertainTeed; SAINT-GOBAIN.
c. Georgia-Pacific Gypsum LLC.
d. Gold Bond Building Products, LLC provided by National Gypsum Company.
e. PABCO Gypsum.
f. USG Corporation.

2. Core: 5/8 inch (15.9 mm), Type X.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:

a. Cornerbead.
b. LC-Bead: J-shaped; exposed long flange receives joint compound.
c. L-Bead: L-shaped; exposed long flange receives joint compound.
d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
e. Expansion (control) joint.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Fry Reglet Corporation; 1/2" reveals or a comparable product by one of the following:

a. Flannery, Inc.
b. Gordon Inc.
c. Pittcon Industries.
d. Tamlyn.

2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B221 (ASTM B221M), Alloy 6063-T5.
3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.
B. Joint Tape:

1. Interior Gypsum Board: Paper.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.

a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

2.7 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

1. Verify adhesives have a VOC content of 50 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify building concentration of formaldehyde does not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. M, and acetaldehyde concentration does not exceed 9 mcg/cu. m.

C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
2. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
3. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.

D. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

1. Verify sealant has a VOC content of 250 g/L or less.
2. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify building concentration of formaldehyde does not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and acetaldehyde concentration does not exceed 9 mcg/cu. m.

E. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

A. Comply with ASTM C840.
B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered

edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:
1. Type X: Vertical surfaces unless otherwise indicated.
2. Ceiling Type: Ceiling surfaces.
3. Abuse-Resistant Type: As indicated on Drawings.
4. Mold-Resistant Type: As indicated on Drawings.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:
1. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
2. Fastening Methods: Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners.

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 INSTALLATION OF TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
B. Control Joints: Install control joints at locations indicated on Drawings.
C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners unless otherwise indicated.
2. LC-Bead: Use at exposed panel edges.
3. L-Bead: Use where indicated on Drawings.

D. Aluminum Trim: Install in locations indicated on Drawings.

3.5 FINISHING OF GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and in accordance with ASTM C840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

    a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

3. Level 5: Where indicated on Drawings.

3.6 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Porcelain tile.
   2. Ceramic mosaic tile.
   3. Glazed wall tile.
   4. Tile backing panels.
   5. Waterproof/Crack suppression membranes.
   6. Setting material.
   7. Grout materials.

B. Related Requirements:
   1. Section 079200 "Joint Sealants" for sealing of movement joints in tile surfaces.

1.2 DEFINITIONS

A. General: Definitions in ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
B. Face Size: Actual tile size, excluding spacer lugs.
C. Module Size: Actual tile size plus joint width indicated.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

   1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Shop Drawings: Show locations, plans, and elevations, of each type of tile and tile pattern. Show widths, details, and locations of movement joints in tile substrates and finished tile surfaces. Show thresholds.
C. Samples for Verification:

   1. Full-size units of each type and composition of tile and for each color and finish required.
   2. Full-size units of each type of trim and accessory for each color and finish required.

3. Metal flooring transitions 6-inch (152-mm) lengths.

D. Sustainable Design Submittals:

1. Environmental Product Declaration: For each product.
2. Third-Party Certifications: For each product.
3. Third-Party Certified Life Cycle Assessment: For each product.
4. Product Data: For adhesives, indicating VOC content.
5. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.
B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
C. Product Certificates: For each type of product, including product use classification.
D. Product Test Reports:

1. Tile-setting and -grouting products.
2. Certified porcelain tile.
3. Slip-resistance test reports from qualified independent testing agency.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:
1. Installer's supervisor for Project holds the International Masonry Institute's Supervisor Certification.
2. Installer employs only Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers for Project.

1.7 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of each type of floor tile installation.
2. Build mockup of each type of wall tile installation.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
D. Store liquid materials in unopened containers and protected from freezing.

1.9 FIELD CONDITIONS

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

1.10 WARRANTY

A. System Warranty: Manufacturer's non-prorated comprehensive warranty that agrees to repair and replace defective installation areas, material, and labor that fail under normal usage within specified warranty period.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Tile: Obtain tile of each color or finish from single source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Tiling System: Obtain system products from single manufacturer and each aggregate from single source or producer.

1. Obtain setting and grouting materials, except for unmodified portland cement and aggregate, from single manufacturer.
2. Obtain underlayment from manufacturer of setting and grouting materials.
3. Obtain waterproof membrane, crack isolation, and other required membranes from manufacturer of setting and grouting materials.
4. Obtain joint sealants from manufacturer of setting and grouting materials.

C. Accessory Products: Obtain each of the following products specified in this Section from a single manufacturer:
1. Backer units.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard Grade requirements unless otherwise indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.3 PORCELAIN TILE

A. Porcelain Tile Type PT-1: Unglazed.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. Crossville, Inc.
   b. Daltile; a brand of Dal-Tile Corporation.
   c. Florida Tile, Inc.

2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: As indicated on the drawings.
4. Face Size Variation: Rectified.
5. Thickness: (10.5 mm).
6. Tile Color, Glaze, and Pattern: As indicated by manufacturer's designations.
7. Grout Color: As selected by Architect from manufacturer's full range.

B. Porcelain Tile Type PT-2: Unglazed.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. Crossville, Inc.
   b. Daltile; a brand of Dal-Tile Corporation.
   c. Florida Tile, Inc.

2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: As indicated on the drawings.
4. Face Size Variation: Rectified.
5. Thickness: 15/16".
6. Tile Color, Glaze, and Pattern: As indicated by manufacturer's designations.
7. Grout Color: As selected by Architect from manufacturer's full range.
8. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
   a. Floor Bullnose: Straight, module size 3 by 24 inches.

2.4 CERAMIC MOSAIC TILE

A. Ceramic Mosaic Tile Type CT-2, CT-3: Glazed.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. Crossville, Inc.
   b. Garden State Tile.
   c. Portobello America, Inc.

2. Module Size: As indicated on drawings.
3. Thickness: 1/4 inch (6.4 mm).
4. Face: Pattern of design indicated, with cushion edges.
5. Surface: Smooth, without abrasive admixture.
6. Tile Color and Pattern: As indicated by manufacturer's designations.
7. Grout Color: As indicated by manufacturer's designations.

2.5 GLAZED WALL TILE

A. Glazed Wall Tile Type CT-1:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. Crossville, Inc.
   b. Garden State Tile.
   c. Portobello America, Inc.

2. Module Size: As indicated on drawings.
3. Face Size Variation: Rectified.
4. Thickness: 3/8 inch.

5. Tile Color and Pattern: As indicated by manufacturer's designations.
6. Grout Color: As selected by Architect from manufacturer's full range.
7. Mounting:
8. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
   a. External Corners for Thinset Mortar Installations: Surface bullnose; same size as adjoining flat tile.
   b. Internal Corners: Field-butted square corners. For coved base and cap, use angle pieces designed to fit with stretcher shapes.

2.6 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges in maximum lengths available to minimize end-to-end butt joints.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. CertainTeed; SAINT-GOBAIN.
   b. Custom Building Products.
   c. USG Corporation.

2. Thickness: 5/8".
3. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

2.7 WATERPROOF/CRACK ISOLATION MEMBRANES

A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10and is recommended by manufacturer for application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Custom Building Products; Custom® 9240 Waterproofing and Anti-Fracture Membrane.
   b. LATICRETE SUPERCAP, LLC; Laticrete 9235 Waterproof Membrane.
   c. MAPEI Corporation; Mapelastic™ 400.

C. Waterproof Membrane, Fluid Applied: Liquid-latex rubber or elastomeric polymer.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Custom Building Products; CBP-232 Waterproofing & Anti-Fracture Membrane RedGard Waterproofing and Crack Prevention Membrane
   b. LATICRETE SUPERCAP, LLC; Laticrete Hydro Ban.
   c. MAPEI Corporation; Mapelastic™ AquaDefense.

2.8 SETTING MATERIALS

A. Improved Modified Dry-Set Mortar (Thinset): ANSI A118.15.

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. Custom Building Products.
   b. Laticrete International, Inc.
   c. MAPEI Corporation.

2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to other requirements in ANSI A118.15.

2.9 GROUT MATERIALS

A. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.

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. Custom Building Products.
   b. Laticrete International, Inc.
   c. MAPEI Corporation.

2. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F (60 and 100 deg C), respectively, and certified by manufacturer for intended use.

2.10 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting and adhesive materials for installations indicated.
B. Vapor-Retarder Membrane: Polyethylene sheeting, ASTM D4397, 4.0 mils (0.1 mm) thick.
C. Metal Flooring Transitions: Profile designed specifically for flooring applications; height to match tile and setting-bed thickness.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. Custom Building Products.
   b. Kuberit.
   c. Schluter Systems L.P.

2. Description: Square.
3. Material and Finish: Metallic or combination of metal and PVC or neoprene base; polished nickel anodized aluminum exposed-edge material.

D. Temporary Protective Coating: Formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products and easily removable after grouting is completed without damaging grout or tile.
E. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
F. Grout Sealer: Grout manufacturer's standard product for sealing grout joints that does not change color or appearance of grout.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

    a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

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

3.2 PREPARATION

A. Remove coatings, including curing compounds or other coatings, that are incompatible with tile-setting materials.

B. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

C. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1 and is sloped 1/4 inch per foot (1:50) toward drains.

D. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

E. Substrate Flatness:

1. For tile shorter than 15 inches (381 mm), confirm that structure or substrate is limited to variation of 1/4 inch in 10 ft. (6.4 mm in 3 m) from the required plane, and no more than 1/16 inch in 12 inches (1.5 mm in 300 mm) when measured from tile surface high points.

F. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 INSTALLATION OF CERAMIC TILE SYSTEM

A. Install tile backing panels and treat joints in accordance with ANSI A108.11 and manufacturer's written instructions for type of application indicated.

B. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

1. Allow waterproof membrane to cure and verify by testing that it is watertight before installing tile or setting materials over it.

C. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

1. Allow crack isolation membrane to cure before installing tile or setting materials over it.

D. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

1. Add materials, water, and additives in accurate proportions.
2. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

E. Install tile in accordance with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of ANSI A108 series that are referenced in TCNA installation methods and specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
   a. Tile floors in wet areas.
   b. Tile floors consisting of tiles 8 by 8 inches (200 by 200 mm) or larger.
   c. Tile floors consisting of rib-backed tiles.

2. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
3. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
4. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
5. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

   a. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets, so joints between sheets are not apparent in finished Work.
   b. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
   c. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

F. Movement Joints: Provide movement joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated on Drawings. Form joints during installation of setting materials, mortar beds, and tile. Keep joints free of dirt, debris, and setting materials prior to filling with sealants. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

G. Metal Flooring Transitions: Install at locations indicated and where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.
H. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors in accordance with manufacturer's written instructions. As soon as sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 ADJUSTING AND CLEANING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile in accordance with tile and grout manufacturer's written instructions. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.5 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.6 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:

1. TCNA F125-Full PT-1, PT-2: Thinset mortar on crack isolation membrane.

a. Ceramic Tile Type: Porcelain Tile.
b. Thinset Mortar: Improved modified dry-set mortar.
c. Grout: Water-cleanable epoxy grout.
d. Waterproof / Crack Isolation Membrane: Fluid-applied membrane.
e. Joint Width: 1/8 inch (3.2 mm).
f. Movement Joints: Types located on Drawings.

B. Interior Wall Installations, Wood or Metal Studs or Furring:

1. TCNA W242 CT-1, CT-2, CT-3: Thinset mortar on cementitious backer units or fiber cement backer board.

a. Ceramic Tile Type: Glazed wall tile.
b. Grout: Water-cleanable epoxy grout.
c. Joint Width: 1/8 inch (3.2 mm).

END OF SECTION 093013

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Acoustical panels.
2. Metal suspension system.
3. Metal edge moldings and trim.

B. Related Requirements:

1. Section 095426 "Suspended Wood Ceilings" for ceilings consisting of wood panels in a suspended grid system.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Acoustical panels.
2. Metal suspension system.

B. Sustainable Design Submittals:
1. Environmental Product Declaration: For each product.
2. Third-Party Certifications: For each product.
3. Third-Party Certified Life Cycle Assessment: For each product.
4. VOC Content for each product
5. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20
6. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)

C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1. Acoustical Panels: Set of 6-inch- (150-mm-) square Samples of each type, color, pattern, and texture.

D. Delegated Design Submittals: For seismic restraints for ceiling systems.

1. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension-system members.
2. Structural members to which suspension systems will be attached.
3. Method of attaching hangers to building structure.

    a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.

4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Size and location of initial access modules for acoustical panels.
6. Items penetrating finished ceiling and ceiling-mounted items including the following:

    a. Lighting fixtures.
    b. Diffusers.
    c. Grilles.
    d. Speakers.
    e. Sprinklers.
    f. Access panels.
    g. Perimeter moldings.

7. Show operation of hinged and sliding components covered by or adjacent to acoustical panels.
8. Minimum Drawing Scale: 1/8 inch = 1 foot (1:96).

B. Qualification Data: For testing agency.

C. Product Test Reports: For each acoustical panel ceiling, for tests performed by a qualified testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

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

1. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.
2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Source Limitations for Ceiling System: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic restraints for ceiling systems.
B. Seismic Performance: Suspended ceilings to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.
C. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class A in accordance with ASTM E1264.
2. Smoke-Developed Index: 50 or less.

D. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL or from the listings of another qualified testing agency.

2.3 ACOUSTICAL PANELS APC-1

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Armstrong
2. CertainTeed; SAINT-GOBAIN.
3. Rockfon; ROCKWOOL International.

B. Acoustical Panel Standard: Provide manufacturer's standard panels in accordance with ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

C. Recycled Content: pre- and post-consumer content, where available.

D. Classification: Provide panels as follows:
1. Type and Form, Type IV Form 1 and 2:
2. Pattern: E (lightly textured) G (smooth).

E. Color: White.

F. Light Reflectance (LR): Not less than 0.90.

G. Ceiling Attenuation Class (CAC): Not less than 30.

H. Noise Reduction Coefficient (NRC): Not less than 0.90.

I. Edge/Joint Detail: Shadowline Tapered.

J. Thickness:
1. 1 inch (25 mm).

K. Modular Size: 24 by 24 inches (610 by 610 mm).

L. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested in accordance with ASTM D3273, ASTM D3274, or ASTM G21 and evaluated in accordance with ASTM D3274 or ASTM G21.

2.4 ACOUSTICAL PANELS APC-2

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Armstrong
2. CertainTeed; SAINT-GOBAIN.
3. Rockfon; ROCKWOOL International.

B. Acoustical Panel Standard: Provide manufacturer's standard panels in accordance with ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
C. Recycled Content: pre- and post-consumer content, where available..
D. Classification: Provide panels as follows:
   1. Type and Form, Type XX: High-density, ceramic- and mineral-base panels with scrubbable finish, resistant to heat, moisture, and corrosive fumes.
   2. Pattern: G (smooth).

E. Color: White.
F. Light Reflectance (LR): Not less than 0.77.
G. Ceiling Attenuation Class (CAC): Not less than 35.
H. Noise Reduction Coefficient (NRC): NA.
I. Edge/Joint Detail: Square.
J. Thickness: 1/2 inch
K. Modular Size: 24 by 24 inches (610 by 610 mm).
L. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested in accordance with ASTM D3273, ASTM D3274, or ASTM G21 and evaluated in accordance with ASTM D3274 or ASTM G21.

2.5 METAL SUSPENSION SYSTEM

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   1. Armstrong Ceiling & Wall Solutions.
   2. CertainTeed; SAINT-GOBAIN.
   3. Rockfon; ROCKWOOL International.
   4. USG Corporation.

B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories in accordance with ASTM C635/C635M and designated by type, structural classification, and finish indicated.

   1. High-Humidity Finish: Where indicated, provide coating tested and classified for "severe environment performance" in accordance with ASTM C635/C635M.

C. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

D. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 (Z90) coating designation; with prefinished 15/16-inch- (24-mm-) wide metal caps on flanges.
1. Structural Classification: Heavy-duty system.
2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
3. Face Design: Flat, flush.
4. Cap Material: Cold-rolled steel.
5. Cap Finish: Painted white.

E. Wide-Face, Aluminum-Capped, Double-Web, Hot-Dip Galvanized, G60 (Z180), Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; hot-dip galvanized, G60 (Z180) coating designation; with prefinished, 15/16-inch- (24-mm-) wide aluminum caps on flanges.
1. Structural Classification: Heavy-duty system.
2. Face Design: Flat, flush.
3. Cap Finish: Painted white.

2.6 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing in accordance with ASTM E488/E488M or ASTM E1512 as applicable, conducted by a qualified testing and inspecting agency.

   a. Type: Postinstalled expansion anchors.
   b. Corrosion Protection, Carbon Steel: Components zinc plated in accordance with ASTM B633, Class SC 1 (mild) service condition.

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing in accordance with ASTM E1190, conducted by a qualified testing and inspecting agency.

B. Wire Hangers, Braces, and Ties: Provide wires as follows:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
2. Nickel-Copper-Alloy Wire: ASTM B164, nickel-copper-alloy UNS No. N04400.
3. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- (2.69-mm-) diameter wire.

C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
E. Angle Hangers: Angles with legs not more than 7/8 inch (22 mm) wide; formed with 0.04-inch-(1-mm-) thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.
F. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical panels in place during a seismic event.

2.7 METAL EDGE MOLDINGS AND TRIM

A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

1. Edge moldings to fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.8 ACOUSTICAL SEALANT

A. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION OF ACOUSTICAL PANEL CEILINGS

A. Install acoustical panel ceilings in accordance with ASTM C636/C636M, seismic design requirements, and manufacturer's written instructions.
B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
7. Do not attach hangers to steel deck tabs.
8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
9. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.

1. Arrange directionally patterned acoustical panels as follows:

   a. As indicated on reflected ceiling plans.

2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
6. Install seismic clips in areas indicated; space in accordance with panel manufacturer's written instructions unless otherwise indicated.
7. Protect lighting fixtures and air ducts in accordance with requirements indicated for fire-resistance-rated assembly.

3.4 ERECTION TOLERANCES

A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m), non-cumulative.

B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m), non-cumulative.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Periodic inspection during the installation of suspended ceiling grids in accordance with ASCE/SEI 7.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
C. Acoustical panel ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.

3.6 CLEANING

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

END OF SECTION 095113

SECTION 095426 - SUSPENDED WOOD CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Wood-veneer, flat-panel ceilings.

1.2 DEFINITIONS

A. NRC: Noise Reduction Coefficient.

1.3 COORDINATION

A. Coordinate layout and installation of wood ceilings and suspension systems with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Wood-veneer, flat-panel ceilings.

B. Sustainable Design Submittals:

   1. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
   2. Product Data: For adhesives, indicating VOC content.
   3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
   4. Product Data: For adhesives, indicating VOC content.
   5. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
   6. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
   7. Environmental Product Declaration: For each product.
   8. VOC Content for each product.
   9. For products containing composite wood, provide copies of product labels, chain of custody records or documentation demonstrating compliance with CARB./ATCM formaldehyde regulation.
   10. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20
   11. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)

C. Shop Drawings: For suspended wood ceilings.

1. Include reflected ceiling plans, sections, and details, drawn to scale, showing the following:

a. Wood ceiling patterns and joints.
b. Ceiling suspension members.
c. Method of attaching hangers to building structure and locations of cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
d. Ceiling-mounted items including, but not limited to, light fixtures, diffusers, grilles, speakers, sprinklers, and access panels.
e. Ceiling perimeter and penetrations through ceiling; trim and moldings.

D. Samples for Verification: For the following products:

1. Wood Ceilings: 12-inch- (305-mm-) long by 12-inch- (305-mm-) wide or full-width Samples of each type, color, and finish.
2. Suspension-System Members: 12-inch- (305-mm-) long Sample of each type.
3. Exposed Molding and Trim: 12-inch- (305-mm-) long Samples of each type, color, and finish.

E. Delegated Design Submittals: For design of seismic restraints and attachment devices.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.
B. Product Test Reports: For each suspended wood ceiling, for tests performed by a qualified testing agency.
C. Evaluation Reports: For suspended-wood-ceiling framing systems.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Suspended-Wood-Ceiling Components: Quantity of each wood-ceiling unit, suspension-system component, accessory, and exposed molding and trim equal to 2 percent of quantity installed.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver ceiling components and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they are protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

1. Store materials flat and level, raised from the floor.

B. Handle ceiling components and accessories in a manner that prevents damage.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not install interior ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

1. Store and acclimatize wood products in the spaces where they will be installed for a minimum of 72 hours immediately before ceiling installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements" to design seismic restraints and attachment devices.
B. Seismic Criteria: Provide suspended wood ceilings designed and installed to withstand the effects of earthquake motions in accordance with ASCE/SEI 7 and requirements of authorities having jurisdiction.
C. Certified Wood: Certify wood products in accordance with the American Tree Farm System's "AFF Standard," the AFPA's Sustainable Forestry Initiative, FSC STD-01-001 and FSC STD-40-004, or the standards of the Programme for Endorsement of Forest Certification.
D. Recycled Content of Composite-Wood Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.

2.2 WOOD-VENEER, FLAT-PANEL CEILINGS WPC-1

A. Wood Panels: Manufacturer's standard panels consisting of wood veneer bonded to both faces of composite-wood core with exposed edges and integrated acoustical backer.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. ASI Architectural.

b. Armstrong World Industries, Inc.
c. USG Corporation.

2. Surface-Burning Characteristics: Provide products with the following characteristics when tested in accordance with ASTM E84:

   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 50 or less.

3. Veneer Face Grade: Manufacturer's standard.
4. Veneer Species: Manufacturer's standard.
5. Veneer Cut: Manufacturer's standard.
6. Panel Perforation Pattern: NA.
7. Acoustical Backing: Integrated backer, with flame-spread index of 25 or less and smoke-developed index of or less as determined by testing in accordance with ASTM E84.
8. Panel Module: 24 inches (610 mm) square.
9. Panel Depth: 3/4 inch (19 mm).
10. Panel Edges: Shadowline tapered

    a. Reveal Depth: Manufacturer's standard.
    b. Reveal Width: Manufacturer's standard.

11. Veneer Adhesive: Manufacturer's standard that complies with "Performance Requirements" Article.
12. Factory Finish: Manufacturer's standard finish; applied on every wood surface.

B. Wood-Panel Accessories: Wood-panel manufacturer's accessories required to provide a complete installation of ceiling in accordance with manufacturer's written installation instructions.

1. Attachment Clips: Manufacturer's standard screw attached to back face of panels with square-cut edges to produce concealed-grid installation and allowing downward removal of ceiling panels.
2. Hold-Down Clips: Manufacturer's standard that maintain proper seating of kerfed panel edges.
3. Safety Clips: Manufacturer's standard to prevent panels from dropping when disengaged from the suspension system.
4. Safety Cables: Manufacturer's standard to prevent panels weighing 20 lb (9 kg) or more from falling to floor in event of grid failure.
5. Border Clips: Manufacturer's standard type.
6. Grid-Stabilizer Clips: Manufacturer's standard for oversize panels.
7. Panel-Fixing Clip or Bracket: Manufacturer's standard that positively secures border and cut panels to the suspension system, so they cannot be removed from below.
8. Veneer Edge Banding: Manufacturer's standard matching panels for treating cut edges; with pressure-sensitive adhesive backing.

C. Grid Suspension System: ASTM C635/C635M; recommended in writing by ceiling and suspension-system manufacturers for applications indicated; main- and cross-runner system complete with suspension-system components required to support ceiling units and other ceiling-supported construction.

1. Material: ASTM A653/A653M, hot-dip galvanized, cold-rolled sheet steel, G60 (Z180) coating designation.
2. Structural Classification: Heavy-duty system.
3. Face Width: 15/16 inch (24 mm).
4. Finish: Flat black.

2.3 SUSPENSION-SYSTEM HANGERS, BRACES, AND TIES

A. Attachment Devices: Size for 5 times the design load indicated in ASTM C635/C635M, Table 1, Direct Hung, unless otherwise indicated.

1. Cast-in-Place and Postinstalled Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 5 times that imposed by ceiling construction as determined by testing in accordance with ASTM E488/E488M or ASTM E1512, as applicable, conducted by a qualified testing and inspecting agency.

    a. Type: Cast-in-place Postinstalled expansion anchors.
    b. Corrosion Protection:

        1) Carbon-steel components zinc plated to comply with ASTM B633, Class Fe/Zn 5 (0.005 mm) for Class SC service condition (mild).

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction as determined by testing in accordance with ASTM E1190 conducted by a qualified testing and inspecting agency.

B. Wire Hangers, Braces, and Ties: Provide wire complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
2. Stainless Steel Wire: ASTM A580/A580M, Type 304, nonmagnetic.
3. Nickel-Copper-Alloy Wire: ASTM B164 nickel-copper alloy UNS No. N04400.
4. Size: Select wire diameter so its stress at 3 times the hanger design load indicated in ASTM C635/C635M, Table 1, Direct Hung is less than yield stress of wire, but provide not less than 0.106-inch- (2.7-mm-) diameter wire.

C. Rods and Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
D. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed from 0.04-inch- (1.0-mm-) thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.
E. Seismic Stabilizer Bars: Grid-suspension-system manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing and substrates to which suspended wood ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage, and with requirements for installation tolerances and other conditions affecting performance of suspended wood ceilings.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of suspended wood ceilings.

1. Balance border widths at opposite edges of each ceiling.
2. Avoid using less-than-half-width units.

3.3 INSTALLATION OF SUSPENDED WOOD CEILINGS

A. Comply with ASTM C636/C636M and seismic requirement indicated, in accordance with manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns in 3 inches (76 mm). Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate to which hangers are attached and for type of hanger involved.
5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, power-actuated fasteners, or postinstalled mechanical or adhesive anchors that extend through forms into concrete.
6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
7. Do not attach hangers to steel deck tabs.
8. Do not attach hangers to steel roof deck. Attach hangers to structural members.

9. Space hangers not more than 48 inches (1219 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (203 mm) from ends of each member.
10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns in 1-1/2 inches (38 mm). Suspend bracing from building's structural members as required for hangers and without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim at perimeter of ceiling area and where necessary to conceal edges and ends of wood units.

1. Screw-attach metal moldings to substrate at intervals of not more than 16 inches (406 mm) o.c. and not more than 3 inches (76 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3 mm in 3.7 m). Miter corners accurately and connect securely.
2. Do not use exposed fasteners on moldings and trim.

E. Grid Suspension Systems: Space main beams at 48 inches (1219 mm) o.c.

1. Install cross tees to form 24-inch (610-mm) square modules.
2. Remove and replace dented, bent, or kinked members.

F. Install wood components and accessories in accordance with manufacturer's written instructions and to accommodate natural expansion and contraction of wood products resulting from fluctuations in humidity.

G. Cut wood components for accurate fit at borders and at interruptions and penetrations by other work through ceilings.

1. Stiffen edges of cut wood components as required to eliminate variations in flatness.

H. Treat field-cut edges of wood components in accordance with manufacturer's written recommendations; finish exposed field cuts to match factory finish.
1. Wood-Veneer Units: Edge band exposed field-cut edges.

I. Install wood components in coordination with suspension system and moldings and trim.

1. Install wood components in patterns indicated on Drawings.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Suspended ceiling system.
2. Hangers, anchors, and fasteners.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
C. Tests and Inspections: Testing and inspecting of completed installations of ceiling hangers, anchors, and fasteners to take place in successive stages, in test areas and using methods as follows. Do not proceed with installations of ceiling hangers for the next area until test results for previously completed installations show compliance with requirements.

1. Test Areas: Test installation of ceiling suspension systems on each floor when installation has reached 20 percent completion but before wood ceilings have been installed.

a. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.
b. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.

D. Ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.
E. Prepare test and inspection reports.

3.5 CLEANING

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

END OF SECTION 095426

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

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. Thermoset-rubber base.
2. Rubber stair accessories.
3. Rubber molding accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
3. Product Data: For sealants, indicating VOC content.
4. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
5. Laboratory Test Reports: For resilient base and stair products and accessories, indicating compliance with requirements for low-emitting materials.
6. Environmental Product Declaration: For each product.
7. Third-Party Certifications: For each product.
8. Third-Party Certified Life Cycle Assessment: For each product.
9. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20
10. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)

C. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches (300 mm) long.
D. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.4 MAINTENANCE MATERIAL SUBMITTALS

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

1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.6 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Verify products comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 THERMOSET-RUBBER BASE RB

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Flexco Corporation.

2. Johnsonite; a Tarkett company.
3. Roppe Corporation; Roppe Holding Company.

B. Product Standard: ASTM F1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).

1. Style and Location:
   a. Style B, Cove: .

C. Thickness: 0.125 inch (3.2 mm).
D. Height: As indicated on Drawings.
E. Lengths: Coils in manufacturer's standard length.
F. Outside Corners: Job formed.
G. Inside Corners: Job formed.
H. Colors: As indicated by manufacturer's designations.

2.3 RUBBER STAIR ACCESSORIES RST

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Flexco Corporation.
2. Johnsonite; a Tarkett company.
3. Nora by Interface.
4. Roppe Corporation; Roppe Holding Company.

C. Stair Treads: ASTM F2169.

1. Type: TS (rubber, vulcanized thermoset).
2. Class: 2 (pattern; embossed, grooved, or ribbed).
3. Group: 2 (with contrasting color for the visually impaired).
4. Nosing Style: Square, adjustable to cover angles between 60 and 90 degrees.
5. Nosing Height: 1-1/2 inches (38 mm).
6. Thickness: 1/4 inch (6 mm) and tapered to back edge.
7. Size: Lengths and depths to fit each stair tread in one piece.
8. Integral Risers: Smooth, flat; in height that fully covers substrate.

D. Landing Tile: Matching treads; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.

E. Locations: Provide rubber stair accessories in areas indicated.
F. Colors and Patterns: As indicated by manufacturer's designations.

2.4 RUBBER MOLDING ACCESSORY

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Roppe Corporation; Roppe Holding Company.
2. VPI Corporation.

B. Description: Rubber transition strips.
C. Profile and Dimensions: As indicated.
D. Locations: Provide rubber molding accessories in areas indicated.
E. Colors and Patterns: As selected from Manufacturer's full range.

2.5 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

1. Verify adhesives have a VOC content of 50 g/L or less.

C. Stair-Tread Nose Filler: Two-part epoxy compound recommended by resilient stair-tread manufacturer to fill nosing substrates that do not conform to tread contours.
D. Metal Edge Strips: Extruded aluminum with mill finish, nominal 2 inches (50.8 mm) wide, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.
E. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient stair-tread manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

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

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a a relative humidity level acceptable to manufacturer and installer.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient products until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.
B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
E. Do not stretch resilient base during installation.
F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
G. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.

    a. Form without producing discoloration (whitening) at bends.

2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.

    a. Miter or cope corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.
B. Resilient Stair Accessories:

1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
2. Tightly adhere to substrates throughout length of each piece.

C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
B. Perform the following operations immediately after completing resilient-product installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum horizontal surfaces thoroughly.
3. Damp-mop horizontal surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
D. Floor Polish: Remove soil, adhesive, and blemishes from resilient stair treads before applying liquid floor polish.
E. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096519 - RESILIENT TILE FLOORING

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. Luxury vinyl floor tile.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. VOC Content for each product.
3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
4. Product Data: For chemical-bonding compounds, indicating VOC content.
5. Laboratory Test Reports: For chemical-bonding compounds, indicating compliance with requirements for low-emitting materials.
6. Product Data: For sealants, indicating VOC content.
7. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
8. Laboratory Test Reports: For flooring products, indicating compliance with requirements for low-emitting materials.
9. Environmental Product Declaration: For each product.
10. Third-Party Certifications: For each product.
11. Third-Party Certified Life Cycle Assessment: For each product.
12. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20
13. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)

C. Shop Drawings: For each type of resilient floor tile.

1. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

2. Show details of special patterns.

D. Samples for Verification: Full-size units of each color and pattern of floor tile required.

1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches (230 mm) long, of each color required.

E. Product Schedule: For floor tile. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

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

1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.7 QUALITY ASSURANCE

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

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.9 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
C. Close spaces to traffic during floor tile installation.
D. Close spaces to traffic for 48 hours after floor tile installation.
E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. Verify flooring products comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 LUXURY VINYL FLOOR TILE LVT

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Armstrong Flooring, Inc.
2. Flexco Corporation.
3. Mannington Mills, Inc.
4. Patcraft; a division of Shaw Industries, Inc.

B. Tile Standard: ASTM F1700.

1. Class: Class III, Printed Film Vinyl Tile.
2. Type: B, Embossed Surface.

C. Thickness: 0.120 inch (3.0 mm).
D. Size: 6 by 48 inches.
E. Colors and Patterns: As indicated by manufacturer's designations.

2.3 INSTALLATION MATERIALS

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

1. Verify adhesives have a VOC content of 50 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify building concentration of formaldehyde does not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. M, and acetaldehyde concentration does not exceed 9 mcg/cu. m.

C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

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

3.2 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
B. Concrete Substrates: Prepare according to ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 7 or more than 10 pH.

4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 90 percent relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

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

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.
B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles in pattern indicated.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles in pattern of colors and sizes indicated.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
D. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 096813 - TILE CARPETING

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. Modular carpet tile.

B. Related Requirements:
1. Section 096513 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include manufacturer's written installation recommendations for each type of substrate.

B. Sustainable Design Submittals:

1. Product Data: VOC Content of material. For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
3. Laboratory Test Reports: For flooring products, indicating compliance with requirements for low-emitting materials.
4. Environmental Product Declaration: For each product.
5. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20
6. Third-Party Certifications: For each product.
7. Third-Party Certified Life Cycle Assessment: For each product.
8. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)

C. Shop Drawings: For carpet tile installation, plans showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.

2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

D. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.

E. Product Schedule: For carpet tile. Use same designations indicated on Drawings.
F. Sustainable Product Certification: Provide ANSI/NSF 140 certification for carpet products.

1.4 INFORMATIONAL SUBMITTALS

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

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.6 MAINTENANCE MATERIAL SUBMITTALS

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

1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Carpet and Rug Institute's CRI 104.

1.9 FIELD CONDITIONS

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

1.10 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, the following:

    a. More than 10 percent edge raveling, snags, and runs.
    b. Dimensional instability.
    c. Excess static discharge.
    d. Loss of tuft-bind strength.
    e. Loss of face fiber.
    f. Delamination.

3. Warranty Period: Lifetime Limited Warranty years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE CPT-1

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Bentley Mills, Inc.
2. Interface, Inc.
3. J&J Flooring Group LLC.
4. Mannington Commercial; a business unit of Mannington Mills, Inc.
5. Mohawk Carpet, LLC; The Mohawk Group.
6. Shaw Industries Group, Inc.; Berkshire Hathaway Company.

B. Color: As indicated by manufacturer's designations.
C. Pattern: Allee.
D. Fiber System: TDX Nylon.
E. Pile Characteristic: Level-loop pile.
F. Density: 6,767 oz./cu. yd. (g/cu. cm).
G. Pile Thickness: 0.133 inches (mm) for finished carpet tile according to ASTM D6859.
H. Stitches: 7.0 per inch (mm).
I. Gage: 1/10 ends per inch (mm).
J. Surface Pile Weight: 25 oz./sq. yd. (g/sq. m).
K. Total Weight: 102.9 oz./sq. yd. (g/sq. m) for finished carpet tile.
L. Primary Backing/Backcoating: SYNTHETIC.
M. Secondary Backing: ethos Modular with Omnicoat Technology, 50% recycled content.
N. Size: 9 by 36 inches (226 by 914 mm).
O. Applied Treatments:

1. Soil-Resistance Treatment: Manufacturer's standard treatment.
2. Antimicrobial Treatment: Manufacturer's standard treatment that protects carpet tiles as follows:

a. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.

P. Sustainable Design Requirements:

1. Sustainable Product Certification: Platinum level certification according to ANSI/NSF 140.
2. Verify flooring products comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

Q. Performance Characteristics:
1. Dry Breaking Strength: Not less than 100 lbf (445 N) according to ASTM D2646.
2. Tuft Bind: Not less than 5 lbf (22 N) according to ASTM D1335.
3. Delamination: Not less than 4 lbf/in. (0.7 N/mm) according to ASTM D3936.
4. Dimensional Tolerance: Within 1/32 inch (0.8 mm) of specified size dimensions, as determined by physical measurement.
5. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
6. Noise Reduction Coefficient (NRC): Insert NRC according to ASTM C423.
7. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
8. Colorfastness to Light: Not less than 4 after 60 AFU (AATCC fading units) according to AATCC 16, Option E.
9. Electrostatic Propensity: Less than 3.5 kV according to AATCC 134.

2.2 CARPET TILE CPT-2 AND CPT-3

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Bentley Mills, Inc.
2. Interface, Inc.
3. J&J Flooring Group LLC.
4. Mannington Commercial; a business unit of Mannington Mills, Inc.
5. Mohawk Carpet, LLC; The Mohawk Group.
6. Shaw Industries Group, Inc.; Berkshire Hathaway Company.

B. Color: As indicated by manufacturer's designations.
C. Pattern: Loop Stitch.
D. Fiber System: TDX Nylon.
E. Pile Characteristic: Level-loop pile.
F. Density: 6,811 oz./cu. yd. (g/cu. cm).
G. Pile Thickness: 0.111 inches (mm) for finished carpet tile according to ASTM D6859.
H. Stitches: 7.4 stitches per inch (mm).
I. Gage: 1/10 ends per inch (mm).

J. Surface Pile Weight: 21 oz./sq. yd. (g/sq. m).
K. Total Weight: 98.9 oz./sq. yd. (g/sq. m) for finished carpet tile.
L. Backing System: Ethos Modular.
M. Size: 9 by 36 inches (226 by 914 mm).
N. Applied Treatments:

1. Soil-Resistance Treatment: Manufacturer's standard treatment.
2. Antimicrobial Treatment: Manufacturer's standard treatment that protects carpet tiles as follows:

a. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.

O. Sustainable Design Requirements:

1. Sustainable Product Certification: Platinum level certification according to ANSI/NSF 140.
2. Verify flooring products comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

P. Performance Characteristics:
1. Dry Breaking Strength: Not less than 100 lbf (445 N) according to ASTM D2646.
2. Tuft Bind: Not less than 5 lbf (22 N) according to ASTM D1335.
3. Delamination: Not less than 4 lbf/in. (0.7 N/mm) according to ASTM D3936.
4. Dimensional Tolerance: Within 1/32 inch (0.8 mm) of specified size dimensions, as determined by physical measurement.
5. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
6. Noise Reduction Coefficient (NRC): according to ASTM C423.
7. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
8. Colorfastness to Light: Not less than 4 after 60 AFU (AATCC fading units) according to AATCC 16, Option E.
9. Electrostatic Propensity: Less than 2.1 kV according to AATCC 134.

2.3 CARPET TILE CPT-4

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Bentley Mills, Inc.
2. Interface, Inc.
3. J&J Flooring Group LLC.
4. Mannington Commercial; a business unit of Mannington Mills, Inc.
5. Mohawk Carpet, LLC; The Mohawk Group.
6. Shaw Industries Group, Inc.; Berkshire Hathaway Company.

B. Color: As indicated by manufacturer's designations.
C. Pattern: Abrasive Action II.

D. Fiber System: TDX Nylon.
E. Pile Characteristic: Level-loop pile.
F. Density: 7,513 oz./cu. yd. (g/cu. cm).
G. Pile Thickness: 0.115 inches (mm) for finished carpet tile according to ASTM D6859.
H. Stitches: 8.0 stitches per inch (mm).
I. Gage: 1/12 ends per inch (mm).
J. Surface Pile Weight: 24 oz./sq. yd. (g/sq. m).
K. Total Weight: 101.9 oz./sq. yd. (g/sq. m) for finished carpet tile.
L. Backing System: Ethos Modular.
M. Size: 24 by 24 inches (610 by 610 mm).
N. Applied Treatments:

1. Soil-Resistance Treatment: Manufacturer's standard treatment.
2. Antimicrobial Treatment: Manufacturer's standard treatment that protects carpet tiles as follows:

a. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.

O. Sustainable Design Requirements:

1. Sustainable Product Certification: Platinum level certification according to ANSI/NSF 140.
2. Verify flooring products comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

P. Performance Characteristics:

1. Appearance Retention Rating: Severe traffic, 3.5 minimum according to ASTM D7330.
2. Dry Breaking Strength: Not less than 100 lbf (445 N) according to ASTM D2646.
3. Tuft Bind: Not less than 5 lbf (22 N) according to ASTM D1335.
4. Delamination: Not less than 4 lbf/in. (0.7 N/mm) according to ASTM D3936.

5. Dimensional Tolerance: Within 1/32 inch (0.8 mm) of specified size dimensions, as determined by physical measurement.
6. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
7. Noise Reduction Coefficient (NRC): according to ASTM C423.
8. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
9. Colorfastness to Light: Not less than 4 after 60 AFU (AATCC fading units) according to AATCC 16, Option E.
10. Electrostatic Propensity: Less than 1.5 kV according to AATCC 134.

2.4 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

1. Verify adhesives have a VOC content of 50 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify building concentration of formaldehyde does not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. M, and acetaldehyde concentration does not exceed 9 mcg/cu. m.

C. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.
B. Examine carpet tile for type, color, pattern, and potential defects.
C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.

1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

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

3.2 PREPARATION

A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.
C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.
B. Installation Method: As recommended in writing by carpet tile manufacturer.
C. Maintain dye-lot integrity. Do not mix dye lots in same area.
D. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer.
E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
H. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with the Carpet and Rug Institute's CRI 104, Section 13.7.
C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

SECTION 099114 - EXTERIOR PAINTING (MPI STANDARDS)

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. Surface preparation and application of paint systems on exterior substrates.

a. Concrete.
b. Steel and iron.
c. Galvanized metal.
d. GFRC

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop priming of metal substrates.

1.3 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
B. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
C. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
D. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
E. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.
F. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

B. Samples for Initial Selection: For each type of topcoat product.
C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in the Exterior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.
E. Sustainable Design Submittals:

1. Product Data: For paints and coatings, indicating VOC content.
2. Laboratory Test Reports: For paints and coatings, indicating compliance with requirements for low-emitting materials.
3. Environmental Product Declaration: For each product.
4. Third-Party Certifications: For each product.
5. Third-Party Certified Life Cycle Assessment: For each product.
6. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20
7. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

   a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Sherwin-Williams Company (The).

2.2 PAINT PRODUCTS

A. MPI Standards: Provide products complying with MPI standards indicated and listed in its "MPI Approved Products List."
B. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

2. For each coat in a paint system, provide products recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. Colors: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
D. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.
B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
E. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 3.

F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 INSTALLATION

A. Apply paints in accordance with manufacturer's written instructions and recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in the Exterior Painting Schedule may be omitted on items that are factory primed or factory finished if compatible with intermediate and topcoat coatings and acceptable to intermediate and topcoat paint manufacturers.

B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written instructions, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written instructions.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
3. Allow empty paint cans to dry before disposal.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. Masonry, Nontraffic Surfaces:

1. High-Build Latex System MPI EXT 3.1L: Dry film thickness of not less than 10 mils (0.25 mm).

a. Prime Coat: As recommended in writing by topcoat manufacturer.
   1) S-W Loxon Concrete & Masonry Primer/Sealer, LXN C&M Primer WH
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Latex, exterior, high build.

   1) Sherwin Williams SPR EXT SA EXTRA, AA80W02151.

B. Masonry, Nontraffic Surfaces: (Existing cart barn)

1. High-Build Latex System MPI EXT 3.1L: Dry film thickness of not less than 10 mils (0.25 mm).

a. Prime Coat: As recommended in writing by topcoat manufacturer.
   1) S-W B25W00025 PrepRite Interior/Exterior Latex Block Filler White
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Latex, exterior, high build.

   1) Sherwin Williams SPR EXT SA EXTRA, AA80W02151.

C. Sherwin Williams SPR EXT FL EXTRA, AA80W02151Steel and Iron Substrates: (Steel Stairs / Rails / Pre-primed)

1. Water-Based Light Industrial Coating System:

a. Prime Coat: Primer, galvanized, water based, MPI #134.

1) Sherwin Williams Kem Kromik Universal Metal Primer, B50NZ0006.

b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.

c. Semigloss Topcoat: Light industrial coating, exterior, water based, semigloss (MPI Gloss Level 5), MPI #72

1) Sherwin Williams Acrylic Polyurethane, Acrolon 218 HS – Gloss (Part A) Extra White

D. Steel and Iron Substrates (Hollow Metal Doors / Frames / pre-primed)

1. Water-Based Light Industrial Coating System:

a. Prime Coat: Primer, galvanized, water based, MPI #134.

1) Sherwin Williams Kem Kromik Universal Metal Primer, B50NZ0006.

b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.

c. Semigloss Topcoat: Light industrial coating, exterior, water based, semigloss (MPI Gloss Level 5), MPI #163.

1) Sherwin Williams Waterbased Alkyd Urethane Enamel, B53W01151-PI WB ALK UR SG EW.

E. Galvanized-Metal Substrates:

1. Water-Based Light Industrial Coating System:

a. Prime Coat: Primer, galvanized, water based, MPI #134.

1) Sherwin Williams Pro Industrial Pro-Cryl Universal Acrylic Primer Off White B266W00310

b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.

c. Semigloss Topcoat: Light industrial coating, exterior, water based, semigloss (MPI Gloss Level 5), MPI #94.

1) Sherwin Williams Direct to Metal Enamel Pure White – B55W00101

F. GFRC

1. High-Build Latex System MPI EXT 3.1L: Dry film thickness of not less than 10 mils (0.25 mm).

    a. Prime Coat: As recommended in writing by topcoat manufacturer.
        1) S-W Loxon Concrete & Masonry Primer/Sealer, LXN C&M Primer WH
    b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
    c. Topcoat: Latex, exterior, high build.

        1) Sherwin Williams SPR EXT FL EXTRA, AA80W02151.

END OF SECTION 099114

SECTION 099124 - INTERIOR PAINTING (MPI STANDARDS)

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 surface preparation and the application of paint systems including but not limited to the following interior substrates:

1. Concrete.
2. Steel and iron.
3. Galvanized metal.
4. Wood.
5. Gypsum board.

B. Related Requirements:
1. Section 055213 "Pipe and Tube Railings" for shop priming pipe and tube railings.
2. Section 099300 "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on interior wood substrates.

1.3 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.
G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
2. Indicate VOC content.

B. Sustainable Design Submittals:

1. Product Data: For paints and coatings, indicating VOC content.
2. Laboratory Test Reports: For paints and coatings, indicating compliance with requirements for low-emitting materials.
3. Environmental Product Declaration: For each product.
4. Third-Party Certifications: For each product.
5. Third-Party Certified Life Cycle Assessment: For each product.
6. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20
7. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)

C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

1. Custodial Maintenance Manual: provide maintenance manual for Owner's use. Include the following information:
   a. Area Summary, and overview of entire project.
   b. Area detail, for each substrate, paint product system, color number and sheet.
   c. Product Data Sheet for each product.
   d. Sample of each paint oclor, minimum of 8x8 inches, with manufacturer's designation of color and sheen.
   e. Cleaning and touch-up instructions.
   f. Contact for local supplier.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. The Sherwin-Williams Company.

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products List."
B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. VOC Content: For field applications inside the building, verify wall paints comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Interior Flat Latex Wall Paint: 50 g/L.
2. Interior Nonflat Latex Wall Paint: 150 g/L.

D. VOC Emissions: For field applications inside the building, verify wall paints contain no more than half of the chronic REL of VOCs when tested in accordance with the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify building concentration of formaldehyde does not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and acetaldehyde concentration does not exceed 9 mcg/cu. m.
E. Colors: As indicated in a color schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Wood: 15 percent.
3. Gypsum Board: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
E. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.

F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

H. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 INSTALLATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in equipment rooms:

    a. Equipment, including panelboards.
    b. Uninsulated metal piping.
    c. Uninsulated plastic piping.
    d. Pipe hangers and supports.
    e. Metal conduit.
    f. Plastic conduit.
    g. Tanks that do not have factory-applied final finishes.
    h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.

2. Paint the following work where exposed in occupied spaces:

    a. Equipment, including panelboards.
    b. Uninsulated metal piping.
    c. Uninsulated plastic piping.
    d. Pipe hangers and supports.
    e. Metal conduit.
    f. Plastic conduit.
    g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
    h. Other items as directed by Architect.

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. Dry-Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry-film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry-film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry-film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Traffic Surfaces:

1. Two-Component catalyzed polyamide epoxy coating:

a. Prime Coat: KB58AQ033 ArmorSeal 33 WB Epoxy Primer Sealer (Part A and B)
b. Intermediate Coat: Floor paint, matching topcoat.
c. Topcoat: Epoxy Sealer.

1) Sherwin Williams B67C02000 - Armorseal 1000HS Epoxy

B. Concrete Substrates, Traffic Surfaces (Kitchen)

1. Two-Component catalyzed polyamide epoxy coating:

a. Prime Coat: As required by manufacturer.

b. Intermediate Coat: Floor paint, matching topcoat.
c. Topcoat: Epoxy Coating.

1) Sherwin Williams AS 650 Quartz System – KB58VQ650- ArmorSeal 650 SL/RC Self-Leveling Epoxy (Part A and B)

C. Steel Substrates (Steel Stairs)

1. Water-Based Light-Industrial Coating System, MPI INT 5.1B:

a. Prime Coat: Primer, rust inhibitive.

1) Primer: Sherwin Williams Kem Kromik Universal Metal Primer, B50NZ0006.

b. Intermediate Coat: Light-industrial coating, interior, water based, matching topcoat.
c. Topcoat: Light-industrial coating, interior, water based (MPI Gloss Level 3), MPI #94.
1) Finish: Sherwin Williams Direct to Metal Enamel B55W00101

D. Steel Substrates (Hollow Metal Doors / Frames

1. Water-Based Light-Industrial Coating System, MPI INT 5.1B:

a. Prime Coat: Primer, rust inhibitive.

1) Primer: Sherwin Williams Kem Kromik Universal Metal Primer, B50NZ0006.

b. Intermediate Coat: Light-industrial coating, interior, water based, matching topcoat.
c. Topcoat: Light-industrial coating, interior, water based (MPI Gloss Level 3), MPI #94.
1) Finish: Sherwin Williams B53W01151 – P1 WB ALK UR SG EW.

E. Galvanized-Metal Substrates:

1. Water-Based Light-Industrial Coating System, MPI INT 5.3B:

a. Prime Coat: Primer, galvanized, water based, MPI #134.

1) Primer: B66W00310 - Pro Industrial Pro-Cryl® Universal Acrylic Primer.

b. Intermediate Coat: Light-industrial coating, interior, water based, matching topcoat.
1) B66W00501 - Pro Industrial Multi-Surface Acrylic Gloss

c. Topcoat: Light-industrial coating, interior, water based (MPI Gloss Level 3), MPI #151.

1) B66W00501 - Pro Industrial Multi-Surface Acrylic Gloss.

F. Wood Substrates: Wood trim, Architectural woodwork, and wood board paneling as indicated on Drawings.

1. Water-Based Light-Industrial Coating System, MPI INT 6.3P:

a. Prime Coat: Primer sealer, alkyd, interior, MPI #45.
1) B28W00200 – ProMar 200 Interior Latex Primer

b. Intermediate Coat: Light-industrial coating, interior, water based, matching topcoat.
c. Topcoat: Light-industrial coating, interior, water based, semigloss (MPI Gloss Level 5), MPI #153.
1) B20W04651 - ProMar® 400 Zero VOC Interior Latex Eg-Shel / Low Sheen. Exposed metal ceilings

2. Water-Based Dry-Fall System

a. Prime Coat: Shop primer specified in Section where substrate is specified.
b. Topcoat: Dry fall, latex, flat, MPI #118.

1) Sherwin Williams B42W00181 – Pro Industrial Waterborne Acrylic Dryfall Flat (address all rust and Passivators prior to coating).

G. Gypsum Board Substrates:

1. High-Performance Architectural Latex System, MPI INT 9.2B:

a. Prime Coat: Primer sealer, latex, interior, MPI #50.
1) B28W00200 – ProMar 200 Interior Latex Primer

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
1) B20W04651 - ProMar® 400 Zero VOC Interior Latex Eg-Shel / Low Sheen

c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2), MPI #138.
1) B20W04651 - ProMar® 400 Zero VOC Interior Latex Eg-Shel / Low Sheen. (Flat at ceilings)

2. Epoxy-Modified Latex System MPI INT 9.2F: Toilet Rooms, Kitchen and elsewhere as indicated on Drawings

a. Prime Coat: Primer sealer, latex, interior, MPI #50.
1) B28W00200 – ProMar 200 Interior Latex Primer

b. Intermediate Coat: Epoxy-modified latex, matching topcoat.
c. Topcoat: Epoxy-modified latex, semi-gloss (MPI Gloss Level 5), MPI #215.
    1) K45W00151 – Pro Industrial PreCatalyzed Waterbased Epoxy Eg-Shel

END OF SECTION 099124

SECTION 099300 - STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Primers
2. Wood stains.
3. Transparent finishes.

B. Related Requirements:

1. Section 099123 "Interior Painting" for stains and transparent finishes on concrete floors.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.
2. Include preparation requirements and application instructions.
3. Indicate VOC content.

B. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.

C. Samples for Verification: Sample for each type of finish system and in each color and gloss of finish required on representative samples of actual wood substrates.

1. Size: 8 inches (200 mm) square or 8 inches (200 mm) long.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

E. Sustainable Design Submittals:

1. Product Data: For paints and coatings, indicating VOC content.
2. Laboratory Test Reports: For paints and coatings, indicating compliance with requirements for low-emitting materials.
3. Environmental Product Declaration: For each product.
4. Third-Party Certifications: For each product.
5. Third-Party Certified Life Cycle Assessment: For each product.
6. VOC Limits – Reference Green Globes requirements for VOC limits.

7. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20
8. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)

1.3 MOCKUPS

A. Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under Sample submittals and to set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.

   a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
   b. Other Items: Architect will designate items or areas required.

2. Final approval of stain color selections will be based on mockups.

   a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Architect at no added cost to Owner.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.5 FIELD CONDITIONS

A. Apply finishes only when temperature of surfaces to be finished and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
B. Do not apply finishes when relative humidity exceeds 85 percent, at temperatures of less than 5 deg F (3 deg C) above the dew point, or to damp or wet surfaces.
C. Do not apply exterior finishes in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Sherwin-Williams Company (The).

2.2 SOURCE LIMITATIONS

A. Source Limitations: Obtain each coating product from single source from single manufacturer.

2.3 MATERIALS, GENERAL

A. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

B. VOC Emissions: For field applications inside the building, verify wall paints contain no more than half of the chronic REL of VOCs when tested in accordance with the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify building concentration of formaldehyde does not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and acetaldehyde concentration does not exceed 9 mcg/cu. m.

C. Stain Colors: Match Architect's samples.

2.4 PRIMERS

A. Alkyd Sanding Sealer, Interior, Solvent Based, Clear: Solvent-based, quick-drying, clear, sandable alkyd sealer used on new interior wood surfaces that are to be top-coated with an alkyd varnish.

1. The Sherwin Williams Company
   a. Minwax Performance Series Fast Dry Sanding Sealer, 4.0 mils wet / 1.0-1.3 mils dry

2.5 WOOD STAINS

A. Stain, Interior, Semitransparent, for Interior Wood: Solvent-based, oil or oil/alkyd, semitransparent, pigmented stain for new interior wood surfaces that are to be finished with a clear varnish.

1. The Sherwin Williams Company
   a. Minwax Performance Series Tintable Wood Stain

2.6 TRANSPARENT FINISHES

A. Varnish, Interior, Water Based, Clear, Satin: Water-based clear satin coating for interior wood trim, frames, doors, paneling and cabinetry.

1. The Sherwin Williams Company
   a. Minwax Polycrylic Protective Finish Satin

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
B. Maximum Moisture Content of Exterior Wood Substrates: 15 percent, when measured with an electronic moisture meter.
C. Maximum Moisture Content of Interior Wood Substrates: 13 percent, when measured with an electronic moisture meter.
D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
E. Proceed with finish application only after unsatisfactory conditions have been corrected.

1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.

1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

B. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each substrate condition and as specified.

1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

C. Interior Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Apply wood filler paste to open-grain woods to produce smooth, glasslike finish.
3. Sand surfaces exposed to view and dust off.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dry.

3.3 APPLICATION

A. Apply finishes according to manufacturer's written instructions.

1. Use applicators and techniques suited for finish and substrate indicated.
2. Finish surfaces behind movable equipment and furniture same as similar exposed surfaces.
3. Do not apply finishes over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
B. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
C. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
D. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.5 INTERIOR WOOD-FINISH-SYSTEM SCHEDULE

A. Wood Substrates, Glued-Laminated Construction:

1. Water-Based Varnish over Stain System:

a. Stain Coat: Stain, semitransparent, for interior wood.
b. First Intermediate Coat: Water-based varnish matching topcoat.
c. Second Intermediate Coat: Water-based varnish matching topcoat.
d. Topcoat: Varnish, water based, clear, satin.

B. Wood Substrates, Wood Trim, Architectural Woodwork, and Wood Board Paneling:

1. Water-Based Varnish over Stain System:

    a. Stain Coat: Stain, semitransparent, for interior wood.
    b. First Intermediate Coat: Water-based varnish matching topcoat.
    c. Second Intermediate Coat: Water-based varnish matching topcoat.
    d. Topcoat: Varnish, water based, clear, satin.

END OF SECTION 099300

SECTION 101416 - PLAQUES

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 plaques.

1.3 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Environmental Product Declaration: For each product.
3. Third-Party Certifications: For each product.
4. Third-Party Certified Life Cycle Assessment: For each product.
5. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20
6. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)

C. Shop Drawings: For plaques.

1. Include fabrication and installation details and attachments to other work.
2. Show plaque mounting heights, locations of supplementary supports to be provided by others, and accessories.
3. Show message list, typestyles, graphic elements, and layout for each plaque at least half size.

D. Samples for Initial Selection: For each type of plaque, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

E. Samples for Verification: For each type of plaque showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Plaques: 3"x3" minimum.

F. Plaque Schedule: Use same designations specified or indicated on Drawings or in a plaque or sign schedule.

1.5 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For plaques to include in maintenance manuals.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of plaques that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of finishes beyond normal weathering.
b. Deterioration of embedded graphic image.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PLAQUES, GENERAL

A. Regional Materials: Products shall be manufactured within 500 miles (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for signs.

2.3 PLAQUES

A. Cast Plaque (Building Dedication Plaque): Plaque with background texture, border, and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

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. Gemini Incorporated.
   b. Metal Arts.
   c. Metallic Arts.

2. Plaque Material: Cast bronze as selected from manufacturer standards.
3. Plaque Thickness: 0.50 inch (12.7 mm).
4. Finishes:

   a. Integral Metal Finish: As selected by Architect from full range of industry finishes.
   b. Overcoat: Manufacturer's standard baked-on clear coating.

5. Background Texture: As selected by Architect from manufacturer's full range.
6. Integrally Cast Border Style: Square single line, polished.
7. Mounting: Concealed studs.
8. Text and Typeface: Accessible raised characters and Braille typeface as selected by Architect from manufacturer's full range and variable content as scheduled. Finish raised characters to contrast with background color, and finish Braille to match background color.
9. Schedule:
   a. Building Dedication Plaque – minimize size 36" wide by 30" high with text and campus logo.

2.4 MATERIALS

A. Aluminum Castings: ASTM B 26/B 26M, alloy and temper recommended by plaque manufacturer for casting process used and for type of use and finish indicated.
B. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
C. Bronze Castings: ASTM B 584, alloy recommended by manufacturer and finisher for finish indicated.
D. Bronze Plate: ASTM B 36/B 36M, alloy recommended by manufacturer and finisher for finish indicated.

2.5 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of plaques, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
3. Plaque Mounting Fasteners:

    a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of plaque, screwed into back of plaque, or screwed into tapped lugs cast integrally into back of plaque, unless otherwise indicated.

B. Adhesive: As recommended by plaque manufacturer.

1. Adhesives shall have a VOC content of 70 g/L or less.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.6 FABRICATION

A. General: Provide manufacturer's standard plaques according to requirements indicated.

1. Preassemble plaques in the shop to greatest extent possible. Disassemble plaques only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
5. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match plaque finish.
6. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

2.7 GENERAL FINISH REQUIREMENTS

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

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.
D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.8 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.
B. Color Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.
C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.9 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
2. Directional Satin Finish: No. 4.

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 plaque work.
B. Verify that plaque-support surfaces are within tolerances to accommodate plaques without gaps or irregularities between backs of plaques and support surfaces unless otherwise indicated.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install plaques using mounting methods indicated and according to manufacturer's written instructions.

1. Install plaques level, plumb, true to line, and at locations and heights indicated, with plaque surfaces free of distortion and other defects in appearance.
2. Install plaques so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that plaque surfaces are clean and free of materials or debris that would impair installation.
4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of plaque. Remove loose debris from hole and substrate surface.
   a. Thin or Hollow Surfaces: Place plaque in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Through Fasteners: Drill holes in substrate using predrilled holes in plaque as template. Countersink holes in plaque if required. Place plaque in position and flush to surface. Install through fasteners and tighten.
3. Brackets: Remove loose debris from substrate surface and install bracket supports in position so that plaque is correctly located and aligned.
4. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of plaque and of suitable quantity to support weight of plaque after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as plaque is applied and to prevent visibility of cured adhesive at plaque edges. Place plaque in position, and push to engage adhesive. Temporarily support plaque in position until adhesive fully sets.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed plaques and plaques that do not comply with specified requirements. Replace plaques with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
B. Remove temporary protective coverings and strippable films as plaques are installed.
C. On completion of installation, clean exposed surfaces of plaques according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain plaques in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101416

SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Dimensional characters.

a. Cast dimensional characters.
b. Cutout dimensional characters.

1.2 COORDINATION

A. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
3. Environmental Product Declaration: For each product.
4. .
5. Third-Party Certifications: For each product.
6. Third-Party Certified Life Cycle Assessment: For each product.
7. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20
8. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)

C. Shop Drawings: For signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, and layout for each sign at least half size.

D. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

E. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Dimensional Characters: Half-size Sample of each type of dimensional character.
2. Exposed Accessories: Half-size Sample of each accessory type.

F. Product Schedule: For dimensional letter signs. Use same designations indicated on Drawings or specified.

G. Delegated Design Submittal: For signs indicated in "Performance Requirements" Article.

1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.
B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify locations of electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of finishes beyond normal weathering.
b. Separation or delamination of sheet materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design sign structure and anchorage of exterior sign type(s) according to structural performance requirements.

B. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.

1. Uniform Wind Load: As indicated on Drawings.
2. Concentrated Horizontal Load: As indicated on Drawings.
3. Other Design Load: As indicated on Drawings
4. Uniform and concentrated loads need not be assumed to act concurrently.

C. Thermal Movements: For exterior fabricated channel dimensional characters, allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 DIMENSIONAL CHARACTERS

A. Cast Characters, Interior letters: Characters with uniform faces, sharp corners, and precisely formed lines and profiles, and as follows:
1. Character Material: Cast aluminum.
2. Character Height: As indicated on Drawings.
3. Thickness: .5 inches minimum
4. Finishes:
   a. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as selected by Architect from manufacturer's full range.
   b. Overcoat: Manufacturer's standard baked-on clear coating.
5. Mounting: Projecting studs.
6. Typeface: To be selected from full range.

B. Cutout Characters Exterior Logo and Letters: Characters with uniform faces; square-cut, smooth, eased edges; precisely formed lines and profiles; and as follows:
1. Character Material: Sheet or plate aluminum.
2. Character Height: As indicated on Drawings.
3. Thickness: 0. 5 inch.
4. Finishes:
   a. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as selected by Architect from manufacturer's full range.

b. Overcoat: Manufacturer's standard baked-on clear coating.

5. Mounting: Projecting studs.

2.3 DIMENSIONAL CHARACTER MATERIALS

A. Aluminum Castings: ASTM B26/B26M, alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated.
B. Aluminum Sheet and Plate: ASTM B209 (ASTM B209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
C. Aluminum Extrusions: ASTM B221 (ASTM B221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
D. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.
E. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish stainless steel devices unless otherwise indicated.
3. Exposed Metal-Fastener Components, General:

a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.

4. Sign Mounting Fasteners:

a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
b. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
c. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.

B. Adhesive: As recommended by sign manufacturer.

1. Verify adhesives have a VOC content of 70; g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify building concentration of formaldehyde does not exceed half of the

indoor recommended exposure limit, or 33 mcg/cu. m, and acetaldehyde concentration does not exceed 9 mcg/cu. m.

C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch (1.14 mm) thick, with adhesive on both sides.
D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
5. Internally brace dimensional characters for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
6. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
7. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.7 ALUMINUM FINISHES

A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.8 STAINLESS STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
2. Directional Satin Finish: No. 4.

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.
B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
C. Verify that electrical service is correctly sized and located to accommodate signs.
D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF DIMENSIONAL CHARACTERS

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

    a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
    b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

    a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
    b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.

3. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
4. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
5. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
B. Remove temporary protective coverings and strippable films as signs are installed.
C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101419

SECTION 102113.17 - PHENOLIC-CORE TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Phenolic-core toilet compartments.

B. Related Requirements:
1. Section 102800 "Toilet, Bath, and Laundry Accessories" for accessories mounted on toilet compartments.

1.2 COORDINATION

A. Coordinate requirements for overhead supports, blocking, reinforcing, and other supports concealed within wall and ceiling to ensure that toilet compartments can be supported and installed as indicated.

1.3 ACTION SUBMITTALS

A. Product Data.

1. Phenolic-core toilet compartments.

a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.

B. Sustainable Design Submittals:
1. Environmental Product Declaration: For each product.
2. Third-Party Certifications: For each product.
3. Third-Party Certified Life Cycle Assessment: For each product.
4. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20
5. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)

C. Shop Drawings:

1. Include plans, elevations, sections, details, and attachment details.
2. Show locations of cutouts for compartment-mounted toilet accessories.
3. Show locations of centerlines of toilet fixtures.
4. Show locations of floor drains.
5. Show ceiling grid, ceiling-mounted items, and overhead support or bracing locations.

D. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of toilet compartment.

1. Include Samples of hardware and accessories involving material and color selection.

E. Samples for Verification: Actual sample of finished products for each type of toilet compartment, hardware, and accessory.

1. Size: Manufacturers' standard size.

F. Delegated Design Submittals: For grab bars mounted on toilet compartment panels, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Include structural design calculations indicating compliance with specified structural-performance requirements.

1.4 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements, and coordinate before fabrication.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain phenolic-core toilet compartments from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 75 or less.
2. Smoke-Developed Index: 450 or less.

B. Structural Performance: Where grab bars are mounted on toilet compartments, design panels to comply with the following requirements:

1. Panels are able to withstand a concentrated load on grab bar of at least 250 lbf (1112 N) applied at any direction and at any point, without deformation of panel.

C. Regulatory Requirements: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1 for toilet compartments designated as accessible.

2.3 PHENOLIC-CORE TOILET COMPARTMENTS

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

1. ASI Accurate Partitions.
2. ASI Global Partitions.
3. American Sanitary Partition Corporation.
4. Bobrick Washroom Equipment, Inc.
5. Bradley Corporation.
6. Partition Systems International of South Carolina (PSISC); Columbia Systems International of South Carolina LLC.

B. Toilet-Enclosure Style: Overhead braced.

C. Door, Panel, and Pilaster Construction: Solid phenolic-core material with melamine facing on both sides fused to substrate during manufacture (not separately laminated), and with eased and polished edges. Provide minimum 3/4-inch- (19-mm-) thick doors and pilasters and minimum 1/2-inch- (13-mm-) thick panels. Provide with no-sightline system consisting of door and pilaster lapped edges on strike side of door and door and pilaster lapped edges on hinge side of door (unless continuous hinge is used).

D. Pilaster Shoes: Formed from stainless steel sheet, not less than 0.031-inch (0.79-mm) nominal thickness and 3 inches (76 mm) high, finished to match hardware.

E. Pilaster Sleeves (Caps): Formed from stainless steel sheet, not less than 0.031-inch (0.79-mm) nominal thickness and 3 inches (76 mm) high, finished to match hardware.

F. Brackets (Fittings):

1. Stirrup Type: Ear or U-brackets, stainless steel.
2. Full-Height (Continuous) Type: Manufacturer's standard design, stainless steel.

G. Phenolic Compartment Finish: One color in each room.

1. Through-Color Phenolic: Manufacturer's standard solid through-color.

a. Color: As selected by Architect from manufacturer's full range.

2.4 HARDWARE AND ACCESSORIES

A. Door Hardware and Accessories, Heavy Duty: Manufacturer's heavy-duty institutional operating hardware and accessories.

1. Hinges: Manufacturer's minimum 0.062-inch- (1.59-mm-) thick, stainless steel continuous, cam type that swings to a closed or partially open position, allowing emergency access by lifting door. Mount with through bolts.
2. Latch and Keeper: Manufacturer's heavy-duty, surface-mounted, cast stainless steel latch unit designed to resist damage due to slamming, with combination rubber-faced door

strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at toilet enclosures designated as accessible. Mount with through bolts.

3. Coat Hook: Manufacturer's heavy-duty, combination cast stainless steel hook and rubber-tipped bumper, sized to prevent inswinging door from hitting compartment-mounted accessories. Mount with through bolts.
4. Door Bumper: Manufacturer's heavy-duty, rubber-tipped, cast stainless steel bumper at outswinging doors. Mount with through bolts.
5. Door Pull: Manufacturer's heavy-duty, cast stainless steel pull at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at toilet enclosures designated as accessible. Mount with through bolts.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.5 MATERIALS

A. Aluminum Castings: ASTM B26/B26M.

B. Aluminum Extrusions: ASTM B221 (ASTM B221M).

C. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.

D. Stainless Steel Castings: ASTM A743/A743M.

2.6 FABRICATION

A. Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

B. Overhead-Braced Units: Manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters and walls to suit floor and wall conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

C. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, inswinging doors for standard toilet enclosures and 36-inch- (914-mm-) wide, outswinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for toilet enclosures designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.

1. Confirm location and adequacy of blocking and supports required for installation.

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

3.2 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

a. Pilasters and Panels or Screens: 1/2 inch (13 mm).
b. Panels or Screens and Walls: 1 inch (25 mm).

2. Full-Height (Continuous) Brackets: Secure panels or screens to walls and to pilasters with full-height brackets.

a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
b. Align brackets at pilasters with brackets at walls.

B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches (44 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

3.3 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware in accordance with hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113.17

SECTION 102600 - WALL AND DOOR PROTECTION

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. Corner guards.

B. Related Requirements:
   1. Section 064023 "Interior Architectural Woodwork.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.

B. Sustainable Design Submittals:
   1. Product Data: For adhesives, indicating VOC content.
   2. VOC Content for each product.
   3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
   4. Environmental Product Declaration: For each product.
   5. Third-Party Certifications: For each product.
   6. Third-Party Certified Life Cycle Assessment: For each product.
   7. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20
   8. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)

C. Shop Drawings: For each type of wall and door protection showing locations and extent.

D. Samples for Initial Selection: For each type of impact-resistant wall-protection unit indicated, in each color and texture specified.

   1. Include Samples of accent strips and accessories to verify color selection.

E. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size indicated below:

1. Corner Guards: 12 inches (300 mm) long. Include example top caps.
2. Abuse-Resistant Wall Covering: 6 by 6 inches (150 by 150 mm) square.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type of exposed plastic material.
B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.

1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Corner-Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, color, and texture of cover installed, but no fewer than two, 48-inch- (1200-mm-) long units.
2. Mounting and Accessory Components: Amounts proportional to the quantities of extra materials. Package mounting and accessory components with each extra material.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1. Maintain room temperature within storage area at not less than 70 deg F (21 deg C) during the period plastic materials are stored.
2. Keep plastic materials out of direct sunlight.
3. Store plastic wall-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F (21 deg C).

a. Store corner-guard covers in a vertical position.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of wall-protection units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
   b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain wall- and door-protection products of each type from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1.

2.3 CORNER GUARDS

A. Surface-Mounted, Opaque-Plastic Corner Guards CG-1: Fabricated as one piece from PVC plastic; with formed edges; fabricated with 90-degree turn to match wall condition.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. Construction Specialties, Inc.
   b. Koroseal Interior Products, LLC.
   c. Wallprotex.
   d. inpro Corporation.

2. Wing Size: Nominal 1-1/8 by 1-1/8 inches (30 by 30 mm).
3. Mounting: Adhesive.
4. Color and Texture: Painted to match wall color.

B. Surface-Mounted, Metal Corner Guards CG-2: Fabricated as one piece from formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Construction Specialties, Inc.
b. Koroseal Interior Products, LLC.
c. inpro Corporation.

2. Material: Stainless-steel sheet, Type 304.

a. Thickness: Minimum 0.0625 inch (1.6 mm).
b. Finish: Directional satin, No. 4.

3. Wing Size: Nominal 3-1/2 by 3-1/2 inches (90 by 90 mm).
4. Corner Radius: 1/8 inch (3 mm).
5. Mounting: Adhesive.

2.4 MATERIALS

A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.
B. Adhesive: As recommended by protection product manufacturer.

1. Verify adhesives have a VOC content of 70 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify building concentration of formaldehyde does not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and acetaldehyde concentration does not exceed 9 mcg/cu. m.

2.5 FABRICATION

A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.
B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.6 FINISHES

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

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.

1. For wall protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

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

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing wall and door protection.
B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. Installation Quality: Install wall protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
B. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.
1. Adjust end and top caps as required to ensure tight seams.

3.4 CLEANING

A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.
B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 102600

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Childcare accessories.
3. Custodial accessories.

B. Related Requirements:

1. Section 088300 "Mirrors" for frameless mirrors.

1.2 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.3 ACTION SUBMITTALS

A. Sustainable Design Submittals:

1. Environmental Product Declaration: For each product.
2. Third-Party Certifications: For each product.
3. Third-Party Certified Life Cycle Assessment: For each product.
4. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20
5. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)

B. Product Data:

1. Public-use washroom accessories.
2. Childcare accessories.
3. Custodial accessories.

C. Product Data Submittals: For each product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.

D. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify accessories using designations indicated.

E. Delegated Design Submittals: For grab bars.

1. Include structural design calculations indicating compliance with specified structural-performance requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For accessories to include in maintenance manuals.

1.6 WARRANTY

A. Manufacturer's Special Warranty for Hand Dryers: Manufacturer agrees to repair or replace hand dryers that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 3 for Motor Brushes, 10 years for all other parts from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 OWNER-FURNISHED MATERIALS

A. Owner-Furnished Contractor Installed Materials:
1. SD Soap Dispenser

2.2 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. Structural Performance: Design accessories and fasteners to comply with the following requirements:

1. Grab Bars: Installed units are able to resist 250 lbf (1112 N) concentrated load applied in any direction and at any point.

2.3 PUBLIC-USE WASHROOM ACCESSORIES

A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.

B. Toilet Tissue (Jumbo-Roll) Dispenser TH:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Tork 56TR or comparable product by one of the following:

   a. Bobrick Washroom Equipment, Inc.
   b. Bradley Corporation.
   c. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.

2. Description: Two-roll unit with sliding panel to expose other roll.
3. Mounting: Surface mounted.
4. Capacity: 9inch- (228- mm-) diameter rolls.
5. Material and Finish: ABS plastic, gray, with translucent front cover.
6. Lockset: Tumbler type.
7. Refill Indicator: Pierced slots at front.

C. Warm-Air Hand Dryer HD:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick B-770/778 or comparable product by one of the following:

   a. ASI-American Specialties, Inc.
   b. Bradley Corporation.
   c. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
   d. Saniflow Corporation; Mediclinics S.A.
   e. Sloan Valve Company.

2. Description: High-speed, warm-air hand dryer.
3. Mounting: Surface mounted.

   a. Protrusion Limit: Installed unit protrudes maximum 4 inches (102 mm) from wall surface.

4. Operation: Infrared-sensor activated with timed power cutoff switch.

   a. Automatic Shutoff: At 90 seconds.

5. Maximum Sound Level: 72 dB.
6. Cover Material and Finish: Cast aluminum cover with white high-gloss epoxy finish electrostatically applied.
7. Electrical Requirements: 115 V, 12 A, 1380 W.

D. Grab Bar GB:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc; B-550 series or a comparable product by one of the following:

    a. ASI-American Specialties, Inc.
    b. Bradley Corporation.
    c. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.

2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.

    a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin).

4. OD: 1-1/2 inches (38 mm).
5. Configuration and Length: As indicated on Drawings.

E. Sanitary-Napkin Disposal Unit ND:

    a. Basis-of-Design Product: Subject to compliance with requirements, provide Sanisac #33W or comparable product by one of the following:
    b. ASI-American Specialties, Inc.
    c. Bobrick Washroom Equipment, Inc.
    d. Bradley Corporation.
    e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.

2. Mounting: Surface mounted.
3. Door or Cover: Self-closing, disposal-opening cover.
4. Receptacle: Removable.
5. Material and Finish: White enamel.

F. Seat-Cover Dispenser TSD:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Rest Assured; 5044W or a comparable product by one of the following:

    a. ASI-American Specialties, Inc.
    b. Bobrick Washroom Equipment, Inc.
    c. Bradley Corporation.
    d. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.

2. Mounting: Surface mounted.
3. Minimum Capacity: 500 seat covers.
4. Exposed Material and Finish: White plastic.

G. Hook: CH

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc; B-2116 or a comparable product by one of the following:

   a. ASI-American Specialties, Inc.
   b. Bradley Corporation.
   c. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.

2. Description: Single-prong unit.

2.4 CHILDCARE ACCESSORIES

A. Source Limitations: Obtain childcare accessories from single source from single manufacturer.
B. Diaper-Changing Station CS:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Koala Kare Products; Bobrick Washroom Equipment, Inc.; KB100-00 Cream by Koala Corporation or a comparable product by one of the following:

   a. ASI-American Specialties, Inc.
   b. Bradley Corporation.
   c. Diaper Deck & Co.
   d. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.

2. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.

   a. Engineered to support minimum of 250 lb (113 kg) static load when opened.

3. Mounting: Surface mounted, with unit projecting not more than 4 inches (102 mm) from wall when closed.
4. Operation: By pneumatic shock-absorbing mechanism.
5. Material and Finish: HDPE in manufacturer's standard color.
6. Liner Dispenser: Provide built-in dispenser for disposable sanitary liners.

2.5 CUSTODIAL ACCESSORIES

A. Source Limitations: Obtain custodial accessories from single source from single manufacturer.
B. Custodial Mop and Broom Holder MBH:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Bobrick Washroom Equipment, Inc.

2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
3. Length: 34 inches (863 mm).

4. Hooks: Four.
5. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

    a. Shelf: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel.
    b. Rod: Approximately 1/4-inch- (6-mm-) diameter stainless steel.

2.6 MATERIALS

A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch- (0.8-mm-) minimum nominal thickness unless otherwise indicated.
B. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch- (0.9-mm-) minimum nominal thickness.
C. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 (Z180) hot-dip zinc coating.
D. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.
E. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by manufacturer or specified in this Section, and tamper and theft resistant where exposed, and of stainless or galvanized steel where concealed.
F. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).

2.7 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories in accordance with manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

    1. Remove temporary labels and protective coatings.

B. Grab Bars: Install to comply with specified structural-performance requirements.
C. Shower Seats: Install to comply with specified structural-performance requirements.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
B. Clean and polish exposed surfaces in accordance with manufacturer's written instructions.

END OF SECTION 102800

SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for the following:

a. Portable fire extinguisher.

B. Related Requirements:

1. Section 104416 "Fire Extinguishers" for portable, hand-carried fire extinguishers accommodated by fire-protection cabinets.

1.2 ACTION SUBMITTALS

A. Sustainable Design Submittals:
1. Environmental Product Declaration: For each product.
2. Third-Party Certifications: For each product.
3. Third-Party Certified Life Cycle Assessment: For each product.
4. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20
5. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)

B. Product Data: For each type of product.

1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.

C. Shop Drawings: For fire-protection cabinets.

1. Include plans, elevations, sections, details, and attachments to other work.

D. Samples for Verification: For each type of exposed finish required, prepared on samples 6 by 6 inches (150 by 150 mm) square.

E. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.2 FIRE-PROTECTION CABINET FEC-SR

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. Babcock-Davis.
2. Guardian Fire Equipment, Inc.
3. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
4. Larsen's Manufacturing Company.
5. Nystrom, Inc.
6. Potter Roemer LLC; a Division of Morris Group International.

B. Fire-Protection Cabinet Type: Suitable for fire extinguisher.
C. Cabinet Construction: Nonrated.
D. Cabinet Material: Aluminum sheet.

1. Shelf: Same metal and finish as cabinet.

E. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).
1. Rolled-Edge Trim: 2-1/2-inch (64-mm) backbend depth.

F. Cabinet Trim Material: Aluminum sheet.
G. Door Material: Aluminum sheet.
H. Door Style: Vertical duo panel with frame.

I. Door Glazing: Tempered float glass (clear).
J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide projecting lever handle with cam-action latch.
2. Provide continuous hinge, of same material and finish as trim,, permitting door to open 180 degrees.

K. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
3. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
4. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.

a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."

1) Location: Applied to cabinet door.
2) Application Process: Decals.
3) Lettering Color: Black.
4) Orientation: Vertical.

L. Materials:

1. Aluminum: ASTM B221 (ASTM B221M) for extruded shapes and aluminum sheet, with strength and durability characteristics of not less than Alloy 6063-T5 for aluminum sheet.

a. Finish: Baked enamel or powder coat.
b. Color: White
2. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.3 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Miter corners and grind smooth.
3. Provide factory-drilled mounting holes.
4. Prepare doors and frames to receive locks.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
2. Fabricate door frames of one-piece construction with edges flanged.
3. Miter and weld perimeter door frames and grind smooth.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.
B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
C. Finish fire-protection cabinets after assembly.
D. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION OF FIRE-PROTECTION CABINETS

A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at height indicated below:

1. Fire-Protection Cabinet Mounting Height: 42 inches (1067 mm) above finished floor to top of fire extinguisher.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
2. Provide inside latch and lock for break-glass panels.
3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

C. Identification:

1. Apply decals at locations indicated.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.
E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.
B. Related Requirements:

1. Section 104413 "Fire Protection Cabinets."

1.2 ACTION SUBMITTALS

A. Sustainable Design Submittals:
1. Environmental Product Declaration.

B. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
C. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.5 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test according to NFPA 10 when testing interval required by NFPA 10 is within the warranty period.
b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Babcock-Davis.
b. Guardian Fire Equipment, Inc.
c. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
d. Larsen's Manufacturing Company.
e. Nystrom, Inc.

2. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.
3. Valves: Manufacturer's standard.
4. Handles and Levers: Manufacturer's standard.
5. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.

B. Multipurpose Dry-Chemical Type in Steel Container FEC-SR OR FE-B: UL-rated 4-A:60-B:C, 10-lb (4.5-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.
C. Purple-K Dry-Chemical Type in Aluminum Container FEC-K-SR: UL-rated 30-B:C, 5-lb (2.3-kg) nominal capacity, with potassium bicarbonate-based dry chemical in enameled-aluminum container.

2.3 MOUNTING BRACKETS FE-B

A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

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. Babcock-Davis.
b. Guardian Fire Equipment, Inc.
c. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
d. Larsen's Manufacturing Company.
e. Nystrom, Inc.

2. Source Limitations: Obtain mounting brackets and fire extinguishers from single source from single manufacturer.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

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

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

1. Mounting Height: Top of fire extinguisher to be at 42 inches (1067 mm) above finished floor.

END OF SECTION 104416

SECTION 107301 - ALUMINUM SUSPENDED HANGING CANOPY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. The Section includes the following: Design, fabrication, and installation of welded extruded aluminum canpoy systems and canopy systems. Canopy System notation are used interchangeably in the documents.

1.3 REFERENCES

A. The Aluminum Association (AA):
   1. The Aluminum Design Manual 2000, Specifications & Guidelines for Aluminum Structures.

B. American Architectural Manufacturers Association (AAMA):
   1. AAMA 611, Voluntary Specification for Anodized Architectural Aluminum.
   2. AAMA 2603, Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
   3. AAMA 2604, Voluntary Specification, Performance Requirements and Test Procedures for High Performing Organic Coatings on Aluminum Extrusions and Panels.
   4. AAMA 2605, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

C. American Society of Civil Engineers (ASCE):
   1. ASCE 7, Minimum Design Loads for Buildings and Other Structures.

D. American Society for Testing and Materials (ASTM):
   1. ASTM B 209, Specification for Aluminum and Aluminum- Alloy Sheet and Plate.
   2. ASTM B 221, Specification for Aluminum and Aluminum- Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
   3. ASTM C 150, Specification for Portland Cement.

E. American Welding Society (AWS):
   1. ANSI/AWS D1.2, Structural Welding Code - Aluminum.

1.4 PERFORMANCE REQUIREMENTS

A. Design Requirements:

1. Design Canopy in accordance with The Aluminum Design Manual 2000.
2. Comply with the wind requirements of 2018 International Building Code (IBC) and ASCE 7.
3. Provide an all welded extruded aluminum system complete with internal drainage. Non-welded systems are not acceptable.
4. Provide expansion joints to accommodate temperature changes of 120 degrees F. Provide expansion joints with no metal to metal contact.

B. General: Provide aluminum-framed systems, including anchorage, capable of withstanding, without failure, the effects of the following:

1. Structural loads.
2. Thermal movements.
3. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
4. Dimensional tolerances of building frame and other adjacent construction.
5. Failure includes the following:

    a. Deflection exceeding specified limits.
    b. Thermal stresses transferred to building structure.
    c. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
    d. Noise or vibration created by wind and thermal and structural movements.
    e. Loosening or weakening of fasteners, attachments, and other components.
    f. Sealant failure.

C. Structural Loads:

1. Wind Load Criteria: As indicated on Drawings.
2. Seismic Load Criteria: As indicated on Drawings.

1.5 SUBMITTALS

A. Sustainable Design Submittals:
1. Environmental Product Declaration: For each product.
2. Third-Party Certifications: For each product.
3. Third-Party Certified Life Cycle Assessment: For each product.
4. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)

B. Product Data: Manufacturer's product information, specifications, and installation instructions for canopy components and accessories.
C. Shop Drawings: Include plan dimensions, elevations, details, and reactions for connection to structure.
D. Samples:
1. Verification: 3-inch-square samples of each finish selected on the substrate specified.

E. Design Data: Design calculations bearing the seal of a Registered Professional Engineer, licensed in South Carolina. Design calculations shall state that the canopy cover system design complies with the wind and seismic requirements of 2018 IBC and ASCE 7, the stability criteria of applicable building code, and all other governing criteria.

F. Sustainable Design Submittals:

1. Environmental Product Declaration: For each product.

1.6 PROJECT CONDITIONS

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

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating aluminum-framed systems without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: At least ten years experience in the design, fabrication, and erection of extruded aluminum canopy systems.

B. Installer Qualifications: Capable of assuming engineering responsibility and performing work of this Section and who is acceptable to manufacturer.

1. Engineering Responsibility: Preparation of data for aluminum-framed systems including Shop Drawings based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project and submission of reports of tests performed on manufacturer's standard assemblies.

C. Installer Qualifications: Canopy shall be installed by manufacturer, third party installation is not acceptable.

D. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

E. Welding: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code--Aluminum."

F. Testing Agency Qualifications: Minimum ICC certified.

1.8 DELIVERY AND STORAGE

1. Deliver and store all items in protected areas. Keep free of any damage. Replace any damaged items or parts at no cost to the Owner.

1.9 WARRANTY

A. Special Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that deteriorate as defined in this Section within specified warranty period. Intention of Warranty is the manufacturer will come to the job site and do all necessary to correct deficiencies.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Deterioration of metals and other materials beyond normal weathering.
c. Adhesive or cohesive sealant failures.
d. Water leakage through roof system.
e. Failure of operating components to function properly.

2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCT

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. Dittmer Architectural Aluminum.
2. E.L. Burns Company.
3. Mason-Corporation – Mason-Florida.
4. Perfection Architectural Systems, Inc.
5. Tennessee Valley Metals, Inc.
6. American Walkway Covers, LLC.
7. Peachtree Protective Covers, Inc.,

2.2 MATERIALS

A. Aluminum Members: Extruded aluminum, ASTM B 221, 6063 alloy, T6 temper.
B. Fasteners: Aluminum, 18-8 stainless steel, or 300 series stainless steel. (rivets not permitted in deck)
C. Gaskets: Dry seal santoprene pressure type.

D. Aluminum Flashing: ASTM B 209, Type 3003 H14, 0.040 inch, minimum.
E. Fasteners and Bolts: Fasteners and bolts shall be 18-8 non-magnetic stainless steel sealed with neoprene "O" ring beneath 5/8" outside dimension, conical washer.

2.3 FABRICATION

A. General:
   1. Shop Assembly: Assemble components in shop to greatest extent possible to minimize field assembly.
   2. Welding: In accordance with ANSI/AWS D1.2.
   3. Frame Construction: Factory assemble gutter fascia frames to form one-piece welded frame. Make welds smooth and uniform using an inert gas shielded arc. Perform suitable edge preparation to assure 100% penetration. Grind welds only where interfering with adjoining structure to allow for flush connection. Field welding is not permitted.
   4. Deck Construction: Fabricate from extruded modules that interlock in a self-flashing manner. Positively fasten interlocking joints at 8 inches on center creating a monolithic structural unit capable of developing the full strength of the sections. The fastenings must have minimum shear strength of 350 pounds each. Assemble deck with sufficient camber to offset dead load deflection.
   5. All exposed fasteners shall match adjacent finish. Exposed fasteners and / or exposed fastener plates shall not be located on the vertical plane of the fascia or beams. Exposed fasteners shall be limited to minimal locations such as the bottom and top of the fascia elements. Location of all exposed fasteners shall be approved by Architect.
   6. Color: Custom color to match architect's sample.

B. Beams: Provide open-top tubular extrusion, top edges thickened for strength and designed to receive deck members in self-flashing manner. Provide structural ties in tops of all beams.
C. Deck: Extruded self-flashing sections interlocking into a composite unit. Provide welded plate closures at deck ends.
D. Gutter Fascia: Manufacturer's standard shape. Provide fascia splices where continuous runs of fascia are jointed.
E. Hanger Assemblies: Provide extruded aluminum hanger rods in manufacturer's standard shapes and sized to meet the loads of the engineered canopy system.
F. Factory Finishing: Finish designations prefixed by AA comply with system established by the AAMA for designating aluminum finishes.
   1. High performance Organic Coating Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions.
      a. Fluoropolymer Two-Coat Coating System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Verify that all concrete, masonry, and roofing work in the vicinity is complete and cleaned.

3.2 ERECTION

A. Erect protective cover true to line, level, and plumb.
B. Install roof deck sections, accessories and related flashing in accordance with manufacturer's instructions. Provide roof slope for rain drainage without ponding water. Align and anchor roof deck units to structural support frames.
C. Provide hairline miters and fitted joints.
D. Install sealant at all penetrations in deck or beam of canopy system to maintain watertight system.

3.3 CLEANING AND PROTECTION

A. Damaged Units: Replace roof deck panels and other components of the work which have been damaged or have deteriorated beyond successful minor repair.
B. Cleaning: Remove protective coverings at time in project sequence which will afford greatest protection of work. Clean finish surfaces as recommended by manufacturer. Maintain in a clean condition during construction.
C. Protect materials during and after installation.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows and in successive stages. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements. Inspect Work for conformance of canopy structure, connections and roof deck connections with the approved shop drawings.
C. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.
D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

END OF SECTION 107301

SECTION 107516 - GROUND-SET FLAGPOLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes ground-set flagpoles made from aluminum.
B. Owner-Furnished Material: Flags.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, operating characteristics, fittings, accessories, and finishes for flagpoles.

B. Shop Drawings: For each flagpole.

1. Include the following

a. Plans, elevations, and attachment details. Show general arrangement, jointing, fittings, accessories, grounding, anchoring, and support.
b. Section, and details of foundation system.

C. Delegated Design Submittals: For flagpoles.
D. Sustainable Design Submittals:
1. Environmental Product Declaration: For each product.
2. Third-Party Certifications: For each product.
3. Third-Party Certified Life Cycle Assessment: For each product.
4. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flagpoles to include in operation and maintenance manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Spiral wrap flagpoles with heavy paper and enclose in a hard fiber tube or other protective container.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain flagpoles as complete units, including fittings, accessories, bases, and anchorage devices, from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design flagpole assemblies.
B. Seismic Performance: Flagpole assemblies to withstand the effects of earthquake motions determined according to ASCE/SEI 7.
C. Structural Performance: Flagpole assemblies, including anchorages and supports, to withstand design loads indicated within limits and under conditions indicated.

1. Wind Loads: Determine according to NAAMM FP 1001. Basic wind speed for Project location is as shown on Code Analysis
2. Base flagpole design on polyester flags of maximum standard size suitable for use with flagpole or flag size indicated, whichever is more stringent.

2.3 ALUMINUM FLAGPOLES

A. Aluminum Flagpoles: Cone-tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B241/B241M, Alloy 6063, with a minimum wall thickness of 3/16 inch (4.8 mm).

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Acme Lingo Flagpoles.
b. American Flagpole.
c. Baartol Company.
d. Concord American Flagpole.
e. Eder Flag Manufacturing Company, Inc.
f. Ewing Flagpole Co., Inc.; Ewing Group Company.
g. Morgan-Francis Flagpoles and Accessories.
h. Pole-Tech Co., Inc.
i. US Flag & Flagpole Supply, LLC.

B. Exposed Height: 25 feet (7.5 m) and 30 feet (9 m).
C. Construct flagpoles in one piece if possible. If more than one piece is necessary, comply with the following:

1. Fabricate shop and field joints without using fasteners, screw collars, or lead calking.
2. Provide flush hairline joints using self-aligning, snug-fitting, internal sleeves.

D. Metal Foundation Tube: Manufacturer's standard corrugated-steel foundation tube, 0.060-inch (1.52-mm) wall thickness with 3/16-inch (4.8-mm) steel bottom plate and support plate; 3/4-inch- (19-mm-) diameter, steel ground spike; and steel centering wedges welded together. Galvanize foundation tube after assembly. Furnish loose hardwood wedges at top of foundation tube for plumbing pole.

1. Flashing Collar: Same material and finish as flagpole.

E. Sleeve for Aluminum Flagpole: Fiberglass or PVC pipe foundation sleeve, made to fit flagpole, for casting into concrete foundation.

1. Flashing Collar: Same material and finish as flagpole.

F. Cast-Metal Shoe Base: Made from aluminum with same finish and color as flagpoles for anchor-bolt mounting; furnish with anchor bolts.

1. Furnish ground spike.

2.4 FITTINGS

A. Finial Ball: Flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter.

1. 0.063-inch (1.6-mm) spun aluminum, finished to match flagpole.

B. Internal Halyard, Winch System: Manually operated winch with control stop device and removable handle, stainless steel cable halyard, and concealed revolving truck assembly with plastic-coated counterweight and sling. Furnish flush access door secured with cylinder lock. Finish truck assembly to match flagpole.

1. Halyard Flag Snaps: Stainless steel swivel snap hooks with neoprene or vinyl covers. Furnish two per halyard.

2.5 MISCELLANEOUS MATERIALS

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M.
B. Drainage Material: Crushed stone, or crushed or uncrushed gravel; coarse aggregate.
C. Sand: ASTM C33/C33M, fine aggregate.
D. Elastomeric Joint Sealant: Multicomponent nonsag urethane joint sealant complying with requirements in Section 079200 "Joint Sealants."
E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.6 ALUMINUM FINISHES

A. Natural Satin Finish: AA-M32, fine, directional, medium satin polish; buff complying with AA-M20; seal aluminum surfaces with clear, hard-coat wax.

2.7 STAINLESS STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
2. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare uncoated metal flagpoles that are set in foundation tubes by painting below-grade portions with a heavy coat of bituminous paint.
B. Foundation Excavation: Excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete. Place and compact drainage material at excavation bottom.
C. Provide forms where required due to unstable soil conditions and for perimeter of flagpole base at grade. Secure and brace forms to prevent displacement during concreting.
D. Foundation Tube: Place foundation tube, center, and brace to prevent displacement during concreting. Place concrete. Plumb and level foundation tube and allow concrete to cure.
E. Sleeves: Locate and secure sleeves in forms by bracing to reinforcement and forms.
F. Anchor Bolts: Locate and secure anchor bolts in forms with templates and by tying to reinforcement.
G. Place concrete, as specified in Section 033000 "Cast-in-Place Concrete." Compact concrete in place by using vibrators. Moist-cure exposed concrete for no fewer than seven days or use nonstaining curing compound.
H. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance. Provide positive slope for water runoff to perimeter of concrete base.

3.2 FLAGPOLE INSTALLATION

A. General: Install flagpoles where indicated and according to Shop Drawings and manufacturer's written instructions.

B. Foundation Tube: Place flagpole in tube, seated on bottom plate between steel centering wedges, and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a 2-inch (50-mm) layer of elastomeric joint sealant and cover with flashing collar.

C. Baseplate: Cast anchor bolts in concrete foundation. Install baseplate on washers placed over leveling nuts on anchor bolts and adjust until flagpole is plumb. After flagpole is plumb, tighten retaining nuts and fill space under baseplate solidly with nonshrink, nonmetallic grout. Finish exposed grout surfaces smooth and slope 45 degrees away from edges of baseplate.

END OF SECTION 107516

SECTION 114000 – FOODSERVICE EQUIPMENT

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SCOPE

A. These specifications are issued to cover all items in connection with the complete equipment package of the Foodservice Equipment as hereinafter specified and shown on the drawings issued in connection with this project. The Kitchen Equipment Contractor shall have at least five years successful experience furnishing and installing foodservice equipment on projects similar in size and scope to that required for this project and be a recognized distributor for the items of equipment specified herein. The Kitchen Equipment Contractor shall have the financial resources to enable him to handle the work in a satisfactory manner and to deliver the required items of equipment so as not to delay progress of the work. The Kitchen Equipment Contractor shall be fully capable of fulfilling the terms and conditions of the warranty provisions required and, if required, capable of providing a performance bond.

B. The equipment herein specified, with the exception of manufactured or standard catalog items shall be fabricated in a shop bearing the name of a recognized Foodservice Equipment Fabricator. This concern shall be in good standing and shall have at least five years experience in similar work. All custom fabrication shall be fabricated in the same shop.

C. Provide labor and material required to deliver, uncrate, assemble, set in place, level, install, supervise and coordinate the installation of the foodservice equipment and accessories as indicated on drawings and as specified, exclusive of utility connections.

D. Work NOT included in this contract shall include, but is NOT limited to:
   1. All electrical, gas, steam, water and waste services to rough-in points at fixture locations, any required field/site interconnections and final connections to fixtures, except where specified otherwise in item specifications.
   2. Exhaust ductwork upstream from exhaust hood collar, connection to the exhaust hood, the systems, all switches, controls interlocking devices, etc., necessary for complete and proper system operation, unless noted otherwise in item specification.
   3. Installation of faucets, pre-rinse assemblies, hose stations, pot fillers, vacuum breakers, quick disconnect assemblies, drain assemblies, indirect waste piping, check valves and flow control valves as furnished with equipment, unless noted otherwise in item specifications.
   4. Conduit and conductors from the rough-in to the equipment and between remote controls and the equipment.
   5. Disconnect switches as required by the electrical code.
   6. Concrete work, including curbs, raised bases, floor depressions, cement finishes, tile

overlay, wall and ceiling openings, sleeves, penetrations and fire rated duct enclosure.
7. Temporary light and power required to facilitate the installation of the foodservice equipment.
8. Disconnection and removal of existing equipment which is to be removed or relocated shall be by General Contractor.
9. Storage of existing equipment to be reused shall be by Owner.
10. Installation and connection of existing equipment to be reused shall be by Owner.

1.03 DEFINITIONS AND ABBREVIATIONS

A. "Owner" – Owner or Owner's approved representative including Architect, Engineer and Project Coordinator.

B. The "Consultant" for this section of the work is TriMark SS Kemp, 590 Vista Park Drive, Pittsburgh, PA 15205 and/or 4567 Willow Parkway, Cleveland, OH 44125. The Consultant is responsible to the Architect for ascertaining that the work complies with the requirements of this section.

C. "Equipment Contractor" – Kitchen Equipment Contractor (KEC), is the person or company that will contract for the work specified in this section.

D. "Substantial Completion" – The date of substantial completion of work or designated portion there of is the date certified by Owner when construction is sufficiently complete, in accordance with the contract documents, so Owner can occupy or utilize the work or designated portion thereof for the use for which it is intended.

E. "Furnish" – Kitchen Equipment Contractor to Supply and Deliver to appropriate contractor for installation.

F. "Install" – Kitchen Equipment Contractor Furnish to project site and include unloading, unpacking, assembly, erecting, placing, anchoring, protecting and similar operations; Ready for final utility connections by appropriate contractor.

G. "Provide" – Kitchen Equipment Contractor to Furnish and Install complete; Ready for intended use.

H. Transmit reports submissions, questions or correspondence to the Owner for distribution.

1.04 DISCREPANCIES

A. If, after examination of contract drawings and specifications, any discrepancies, omissions, ambiguities or conflicts are found in or among same, or where there is doubt as to their meaning, the Architect is to be notified at the earliest possible date. Where information sought is not clearly indicated or specified, the Architect will issue an addendum to the contractor clarifying conditions, where addendum will become part of the contract documents. Neither the Architect nor the project coordinator will be responsible for any oral instructions.

1.05 CODES AND STANDARDS

A. All material and workmanship shall comply with all applicable codes, specifications, local ordinances, industry standards, and utility company regulations. In case of differences between codes, specifications, state laws, federal laws, local ordinances, industry standards, utility company regulations and the contract documents, the most stringent shall govern. Kitchen Equipment Contractor shall promptly notify Owner in writing of any such differences.

B. Manufacture and install equipment and accessories in strict compliance with and, if applicable, bear the seal of UL, NEMA, ASME, NSF, AGA, ANSI, SMACNA, OSHA and NFPA.

C. Non-compliance – Should Kitchen Equipment Contractor perform any work that does not comply with the requirements of the applicable building codes, state and federal laws, local ordinances, industry standards, and utility company regulations, contractor shall bear all costs arising in correcting the deficiencies, and hold Owner or its agents harmless form any claim or loss that may result from violations or claims.

D. The plumbing systems shall be installed in accordance with the National Plumbing Code and BOCA code, latest edition.

E. Kitchen Equipment Contractor shall obtain certificate of approval from any department issuing same and turn over to Architect at the completion of the work.

F. Approval of Kitchen Equipment Contractors drawings and other data does not relieve the Kitchen Equipment Contractor from responsibility of complying with codes and regulations. Provide, at no extra charge, equipment, trim and accessories, which may be required by codes and regulations.

1.06 TESTS AND INSPECTIONS

A. Kitchen Equipment Contractor shall provide all required notices, and pay all deposits and fees necessary for the installation test and inspection of all work provided under this specification. Tests shall be conducted as required by the regulations of local and state authorities and other agencies having jurisdiction.

1.07 WARRANTY

A. Kitchen Equipment Contractor shall furnish a warranty covering all labor and materials furnished by it for a period of one year from date of substantial completion of the entire project, or start-up of equipment. Kitchen Equipment Contractor shall agree to repair and make good, at its own expense, any and all defects which may appear in its work during that time when, in the judgment of Owner, such defects arise from defective workmanship and/or imperfect or inferior material.

B. In addition, the above shall not in any way void or abolish the equipment manufacturer's guarantee or warranty on equipment. All such guarantee or warranty certificate shall be delivered to Owner.

C. During warranty period, the Kitchen Equipment Contractor will respond to emergency situations, that is, situations determined to be potentially harmful to the surrounding personnel, equipment or environment.

1.08 SUBMITTAL

A. The Kitchen Equipment Contractor must provide drawings at 1/4" = 1'-0" showing dimensioned location, size, height and, where necessary, capacity of all mechanical services required for each item or equipment, and furnish six sets of said drawings to Architect for distribution to other contractors involved. He shall further prepare six brochures containing illustrations, specifications, line drawings and rough-in information on all brand name items (items not of custom manufacture) hereinafter specified, and deliver them to the Owner for distribution to contractors on job site for their further guidance.

B. The Kitchen Equipment Contractor is to prepare detailed shop drawings at a minimum scale of 3/4" = 1'-0", plus necessary cross sections at a scale of 1-1/2" = 1'-0", showing complete detail of each item of specially fabricated equipment. These drawings based upon floor plans and following item specifications. Drawings to include accurately dimensioned layouts and locations for all galvanized steel bases required or called for hereinafter and furthermore to include accurately dimensioned details and locations of any special wall openings and floor pit detail that are required where items of equipment extend through walls, or recessed in floor.

C. The Kitchen Equipment Contractor shall, within fifteen (15) days after acceptance of the contract, submit to the Owner for approval, a complete list of fixtures, devices, materials and equipment proposed for use in the work. The list shall include the name, address, and phone number of the manufacturer, producer, supplier or distributor together with the trade name, catalog number, model number or other data required for complete identification.

D. If any item is rejected by the Architect as not complying with the specifications, the Kitchen Equipment Contractor shall, within seven (7) days of such a rejection, submit an acceptable substitute.

E. Sustainable Design Submittals:

1. Environmental Product Declaration: Provide for each product.

1.09 SUBSTITUTIONS

A. All substitutions that are to be considered must be of the same size and shape, constructed of the same materials, have the same features, finishes and specific accessories, and meet or exceed the performance of the primary named specifications.

B. All contractors shall submit all proposed substitution equipment manufacturers in writing, 10 days prior to submitting their bid, for review by the foodservice consultant. The foodservice consultant's personnel with have final approval for any/all proposed substitutions. If considered substitutions are <u>not</u> submitted prior to this time line and bid date, it will be presumed by all

parties concerned that none are being offered, and the bid is being submitted in full accordance with the primary named specifications in the bid documents.

PART 2 – PRODUCTS

2.01 MATERIALS, GENERAL

A. The materials used throughout shall be those of reputable manufactures and shall be new and best of their respective kinds. Equipment, fixtures, and materials of similar types shall be of the same manufacturer, except where specifically indicated otherwise. All work shall be installed a neat and workmanlike manner in accordance with the best trade practices and by workmen skilled in each particular branch of the work assigned to them.

B. In all cases where equipment and material are specified in the singular or plural number, it is intended that such reference shall apply to as many such items as are required to complete the installation.

C. Stainless steel sheets or shapes: When specified to be 18-8, Type 304, polished to No.4 finish.

D. Galvanized Iron Sheets: When specified to be zinc G-90 coating.

E. Tubing: When specified to be seamless stainless steel, 16 gauge, 18-8, Type 304, Type 304, polished to a No. 4 finish, 1-5/8" diameter.

F. Plastic Laminate: Complying with NEMA LD 3 and NSF 35 requirements; NSF certified for end-use application indicated; 0.050 inch (1.27 mm) thick for horizontal and vertical surfaces and 0.042 inch (1.07 mm) thick for post-formed surface; smooth texture and easily cleanable.

G. Plywood and Lumber: Provide plywood and lumber as specified in Division 6 Section "Interior Architectural Woodwork."

H. Sealant: ASTM C 920; Type S, Grade NS, Class 25, Use NT. Provide elastomeric sealant NSF certified for end-use application indicated. Provide sealant that, when cured and washed, meets requirements of Food and Drug Administration's 21 CFR, Section 177.2600 for use in areas that come in contact with food.

I. Tempered Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated surfaces), Type I (transparent), Class 1 (clear), Quality q3 (glazing select). Provide products complying with ANSI Z97.1, manufactured by horizontal (roller-hearth) process, and 6 mm thick, unless otherwise indicated. Provide exposed safety edges, if any, seamed before tempering.

J. Plastic: Except for plastic laminate, provide plastic materials and components complying with NSF 51.

K. Sound Deadening: NSF certified, nonabsorbent, hard drying, sound-deadening coating. Provide

coating compound for permanent adhesion to metal in 1/8-inch (3-mm) thickness that does not chip, flake or blister.

L. Paint and Coatings: Provide the types of painting and coating material which after drying and curing, are suitable for use in conjunction with foodservice and which are durable, non-toxic, non-flaking, mildew-resistant and comply with foodservice regulations.

M. Gaskets; NSF certified for end-use application indicated; of rubber, neoprene, or PVC that is nontoxic, stable, odorless, nonabsorbent and unaffected by exposure to foods and cleaning compounds.

N. Cabinet Hardware: NSF certified, stainless steel hardware for equipment items as indicated. Hardware other than stainless steel shall be heavy duty chrome plated brass, with concealed fasteners. Provide master keyed locks. Refrigeration equipment and fabricated equipment door and drawer locks shall be keyed alike and be of sufficient strength to prevent unauthorized entry into locked space.

O. Casters: NSF certified, 4" or 5" diameter, rubber, neoprene or polyurethane tires as specified with 1" tread width, sealed, self-lubricating, non-marking swivel type with a minimum load capacity 200 lbs. Each, with double bearing raceways and sleeve-bearing axles, two casters to have toe brakes.

2.02 PLUMBING REQUIREMENTS

A. Unless furnished as standard trim on specified sink units, faucets shall be chrome plated splash or deck-mounted, as it would apply, and furnished with 1/2" IPS supply and check valves. When specified, faucets with provisions for hose adapters shall have sink unit provisioned so as to receive and have properly installed at T & S Brass vacuum breaker or equal. Faucets and components shall be as follows:

Pre-rinse, backsplash:
T & S Brass B-0133/B-109
T & S Brass B-0133-A12-08 with add on faucet

Pre-rinse, deck mount:
T & S Brass B-0113/B-109
T & S Brass B-0113-A12-08 with add on faucet

Faucet, backsplash:
T & S Brass B-0231 (12" nozzle) or B-0230 (18" nozzle)

Faucet, deck mount:
T & S Brass B-0221

Faucet, 3/4" backsplash:
T & S Brass, B-0290

Pot filler, wall mounted:

T & S Brass B-0610

Hose reel, wall mounted:
T & S Brass B-1403

Mixing faucet Valve:
T & S Brass B-0510

Vacuum breakers Assemblies:
3/4" T & S Brass B-0457 (with slip flanges for mounting on 45 degree surface)
3/4" T & S Brass B-0458 (with slip flanges for mounting on flat surface)
1/2" T & S Brass B-0455 (with slip flanges for mounting on 45 degree surface)
1/2" T & S Brass B-0456 (with slip flanges for mounting on flat surface)

Basket drain assemblies:
Component E38-1012

Twist Handle Waste, 2" NPT drain outlet:
T & S Brass B-3952

Twist handle waste w/ overflow assembly, 2" NPT drain outlet:
T & S Brass B-3952-01

Quick disconnect gas connectors:
Dormont (SIZE)-KIT2S-48 with Restraints

B. Faucets shall be properly tagged with item numbers and delivered to Plumbing Contractor on job. Mounting of faucets to fixtures by Plumbing Contractor.

C. All other fittings, such as stops on hot and cold water service, traps, valves, fittings, supply nipples, etc. furnished and installed by others.

D. Chrome plated vacuum breakers on threaded faucets, hose stations and on fixtures where the water inlets are placed below the water level.

E. Backflow preventers on pre-rinse units.

F. Anti-siphon pressure type vacuum breakers on hose reels.

G. Stainless steel angle flange or deck and wall flange where vacuum breaker extends through equipment.

H. Special valves, regulators, strainers, pressure reducing valves, control valves, thermometers, pressure gauges, keyed water flow restrictors and accessories required by code or necessary for the operation of the equipment.

2.03 ELECTRICAL REQUIREMENTS

A. All electrical systems, components and accessories certified to be in accordance with NEC 70 and installed as specified.

B. Grounded receptacles installed flush-mounted in fabricated equipment shall have stainless steel cover plates. Grounded receptacles installed "free standing" on fabricated equipment shall have stainless steel or chrome plated bodies with stainless steel cover plates.

C. The Kitchen Equipment Contractor to supply for each motor driven appliance or electrical heated unit suitable control switch or starter of proper type in accordance with national electrical code. All switches and controls are to be listed or recognized by Underwriters Laboratory, Inc. controls that are mounted on vertical surfaces of fabricated fixtures set into recessed die-stamped stainless steel cups or otherwise indented to prevent damage.

D. All internal wiring for fabricated equipment items, including all electrical devices built into or forming an integral part of these items furnished by Kitchen Equipment Contractor in the factory with all items wired complete to a junction box within the fixture ready for final connection to building lines by electrical contractor. All custom built food service equipment having warming, cooking, lighting, power distribution, or power outlet devices shall be listed and display the listing label of Underwriting Laboratories, Inc.

E. All cord-connected items must be furnished with cord sets not exceeding 6'-0" in length. All cord sets are to contain an equipment grounding conductor and be furnished with caps or plugs listed or recognized by Underwriters Laboratories, Inc. Cords shall be type SO or SJO and listed by Underwrites Laboratories, Inc.

2.04 CUSTOM FABRICATION, GENERAL

A. Custom fabricated equipment shall be constructed in strict accordance with NSF 2 requirements, contract drawings and be new prime quality and full gauge thickness.

B. Plastic Laminate and Wood Casework: As listed in the Itemized Specifications.

C. Fabricate field-assembled equipment prepared for field joining methods indicated. For metal butt joints, comply with reference SMACNA standard, unless otherwise indicated.

D. Where stainless steel is joined to a dissimilar metal, use stainless steel welding material or fastening devices.

E. Form metal with break bends that are not flaky, scaly or cracked in appearance; where breaks mar uniform surface appearance of material, remove marks by grinding, polishing and finishing.

F. Sheared Metal Edges: Finish free of burrs, fins and irregular projections.

G. Provide surfaces in food zone as defined in NSF 2, free from exposed fasteners. Bolts, screws and rivets are not acceptable on exposed surfaces of equipment.

H. Cap exposed fastener threads, including those inside cabinets, with stainless steel lock washers and stainless steel cap (acorn) nuts.

2.05 COUNTER AND TABLE TOPS

A. Metal tops shall be 14 gauge, 18-8, Type 304 stainless steel. Shop seams and corners welded, ground and polished smooth. Tops shall be reinforced with 12 gauge channel, one channel provided on tops up to 36" wide and two channels on tops over 36" wide. Exposed channels shall be galvanized or stainless steel. Attach top to channel reinforcements with studs welded to the underside of top and cadmium plated lock nuts.

B. Field joints provided in top where necessary and located for practical constructions and consistent with sizes convenient for shipping and accessibility into building. See section entitled "Field Joints" for description of these joints.

C. Metal top open edges shall be turned down 1-3/4" at 90 degrees with a 1/2" return at 15 degrees on the horizontal. Burrs, projections and fins are not acceptable on sheared edges. Neatly grind miters and bullnosed corners to a uniform condition.

D. Tops abutting high fixtures or walls shall be furnished with a backsplash. Backsplash shall be coved up 6" or a specified height and sloped back 2" on a 45 degree angle and down at least 1" to receive 14 gauge, 18-8, Type 304 stainless steel zee clip for anchoring to wall or high fixture, as it would apply on 36" o.c. Close ends of splash to bottom of top.

E. Sound deaden underside of tops with NSF approved sound-deadened mastic.

F. Tops on closed base units shall overhang at least 2" on free sides of unit.

G. Provide a 3/16" high raised die-formed edge around punch or drilled openings.

H. Sinks, when required, shall be 14 gauge, 18-8, Type 304 stainless steel, size as indicated on the drawings and made as an integral part of the top. Sink back, bottom and front shall be formed of one continuous sheet with ends welded into place. Horizontal and vertical corners to have a 3/4" radius. Sink bottoms to be creased, and sloped toward drain. Sink shall be fitted with a basket drain assembly with removable crumb cup or twist handle waste assembly or as specified.

2.06 DISHTABLE TOPS

A. Dishtable tops shall be 14 gauge, 18-8, Type 304 stainless steel. Shop seams and corners welded, ground and polished smooth. Tops shall be reinforced with 12 gauge, 18-8, Type 304 stainless steel channel, one channel provided on tops up to 36" wide and two channels on tops over 36" wide. Attach top to channel reinforcements with studs welded to the underside of top and cadmium plated lock nuts. Slope top with an integral pitch so water runs toward dishmachine. Cove all interior corners (horizontal and vertical) of dishtable on a 3/4" radius

B. Field joints provided in top where necessary and located for practical constructions and consistent with sizes convenient for shipping and accessibility into building. See section entitled "Field Joints" for description of these joints.

C. Dishtable top open edges shall be coved up 3" at 90 degrees with a 1-1/2" dia. rolled rim and

3/4" radius corners. Burrs, projections and fins are not acceptable on sheared edges. Neatly grind miters and bullnosed corners to a uniform condition.

D. Tops abutting high fixtures or walls shall be furnished with a backsplash. Backsplash shall be coved up 8" or a specified height and sloped back 2" on a 45 degree angle and down at least 1" to receive 14 gauge, 18-8, Type 304 stainless steel 'z' clip for anchoring to wall or high fixture, as it would apply on 36" o.c. Close ends of splash to bottom of top.
E. Sound deaden underside of tops with NSF approved sound-deadened mastic.

F. When required, furnish provisions for installing pre-rinse faucet with back flow preventers and vacuum breakers.

2.07 SINKS

A. Sinks shall be 14 gauge, 18-8, Type 304 stainless steel, and made as an integral part of the top. Sink back, bottom and front shall be formed of one continuous sheet with ends welded into place. Horizontal and vertical corners to have a 3/4" radius. Provide double wall partition between each pair of sink compartments with rounded top edge. Provide sinks having two or more compartments with full length, full height flush stainless steel front panel to conceal joint between sinks. Turn back panel at sides and bottom and weld to sink bowl. Sink bottoms to be creased, and sloped toward drain. Sink shall be fitted with a basket drain assembly with removable crumb cup or twist handle waste assembly or as specified.

B. Where required, drainboards shall be 14 gauge, 18-8, Type 304 stainless steel, size as shown on drawings and welded to the sink frame to provide an integral unit.

C. All sink units shall be furnished with faucets and drains as specified under that itemized specifications.

2.08 OPEN BASE UNITS

A. All pipe stands for open base tables or dishtables constructed of 1-5/8" dia. x 16 gauge, 18-8, Type 304 stainless steel tubing uprights; cross braces of 1-1/4" O.D. x 16 gauge, 18-8, Type 304 stainless steel tubing. All joints between legs and cross braces fully welded, ground and polished smooth.

B. Crossrails supplied to reinforce each leg. Legs anchored to closed stainless steel gussets at top only and without crossrails are not acceptable except in the case of sinks. Uprights fitted at top with stainless steel fully enclosed gussets fully welded to reinforcing channel on underside of table top or to the reinforced stainless steel corner pads under the sink corner.

C. All pipe legs fitted with sanitary stainless steel bullet shaped feet, fully enclosed with slightly rounded bottom to protect floor. To have a total adjustment of 1" with thread unexposed.

D. Maximum leg spacing to be 6'-0" o.c.

2.09 UNDERSHELVES

A. 16 gauge, 18-8, Type 304 stainless steel (or 14 gauge per OSDM in Ohio areas) turned down 1-1/2" at 90 degrees with a 1/2" return at 15 degrees below the horizontal. Turn up 2" at walls or adjoining high fixtures with 1/4" horizontal coved corners.

B. Welded to stainless steel legs or body of enclosed base table, as it may apply, with all welds ground and polished to blend with the adjacent surfaces.

C. When welded to legs, notch all corners for tight welded.

2.10 ENCLOSED CABINET BASES

A. Enclosed cabinet bases shall be 16 gauge, 18-8, Type 304 stainless steel. Body enclosed on front and ends with corners square. Ends terminate at operator's side in a 2" wide vertical mullion. Channels to close mullions in accordance with NSF. Walls of cabinet shall be a fully welded seamless assembly with channels and box sections corners. Provide individual compartments separated by a partition, enclosing sinks, machinery and drawers from the balance of the cabinet. Base shall be mounted on 1-5/8" dia. x 16 gauge, 18-8, Type 304 stainless steel legs welded to a stainless steel mounting plate and equipped with stainless steel adjustable bullet feet, unless specified on curb. Feet to have a total adjustment of 1" with thread unexposed.

B. In the case of fixtures fitting against or between walls, the bodies set 1" from the wall line, but tops will extend back to wall line. This will permit adjustment to wall irregularities.

C. Interior shelves in enclosed cabinet bases shall be 16 gauge, 18-8, Type 304 stainless steel, set back construction. Front edge turned down 1-1/2" and under 1/2" at a 45 degree angle. Turn back and sides up 1-1/2" and cove on a 1/4" minimum radius. Tack weld to cabinet body and seal to the cabinet base. Reinforce with channels, the same as specified for tops.

2.11 WALL CABINETS

A. Cabinets shall be 18 gauge, 18-8, Type 304 stainless steel, (or 14 gauge per OSDM in Ohio areas) all welded construction, 15" front to back by 30" high (or as specified), with edges turned down 1 1/2" on all sides. Top shall slope 6" from rear to front. Cabinet interior shall have fixed bottom shelf and two (2) removable, adjustable intermediate shelves. Ends terminate at front in a 2" mullion. Mullions closed in accordance with NSF. Doors shall be double wall and constructed as described in Section 2.12 and 2.13. Back fitted with channels for supporting cabinet to wall.

2.12 COUNTER AND CABINET HINGED DOORS

A. Doors shall be double wall construction with 1/2" thick semi-rigid fiberglass board between the two panels. Door exterior shall be 18 gauge, 18-8, Type 304 stainless steel (or 14 gauge per OSDM in Ohio areas) and interior of 20 gauge, 18-8, Type 304 stainless steel. Doors shall have stainless steel lift off hinge and full length, stainless steel channel pull. Provide rubber button bumpers and cylinder lock, as specified.

2.13 OVERSHELVES

A. 16 gauge, 18-8, Type 304 stainless steel (or 14 gauge per OSDM in Ohio areas) with exposed edges turned down 1-1/2" at 90 degrees with a 1/2" return at 15 degrees on the horizontal or as specified.

B. Turn up 2" at walls or adjoining high fixtures with 1/4 horizontal coved corners at rear and sides.

C. Shelving supports or brackets shall be of 14 gauge, 18-8, Type 304 stainless steel and not exceed 6'-0" o.c. Brackets shall be welded to shelf.

2.14 DRAWERS

A. Drawer assemblies shall be flush mounted double pan construction with semi-rigid fiberglass insulation. Provide each drawer with 18 gauge, 18-8, Type 304 stainless steel 20" x 20" x 5" die stamped drawer insert with horizontal and vertical corners 1 3/4" minimum coved. Drawer insert shall be removable and rest in a stainless steel cradle. Cradle shall be welded to 16 gauge, 18-8, Type 304 stainless steel double pan drawer face. Drawer face to have full-length flush type stainless steel channel pull furnished with ball bearing steel drawer slides and adjustable stops at the fully opened position. Provide two (2) rubber button bumpers, one on each side of drawer face and cylinder lock. Enclose drawers on open base table in an 18 gauge, 18-8, Type 304 stainless steel enclosure.

2.15 SHOP/FIELD JOINTS

A. Keep field joints to a minimum. Provide field joints only when equipment size must be limited for access into building or shipping.

B. Field joint is to be a hairline butt joint mechanically fastened offset "draw" design and located on shop drawings.

C. After bolt installation, all field joints, including edges and splash must be fully welded, ground, and polished to match adjacent surface to achieve a seamless appearance.

D. Stainless steel welds, welded using stainless steel electrodes, shall be free of pits, flaws, discolorations, and peened to remove flux and impurities. Grind welds smooth, polish to original finish of metal, with grain uniform to grain of original sheet. Where grinding, polishing has destroyed grain, restore, blend to omit all traces of welding.

E. Acetylene welding or silver solder is not acceptable.

F. All concealed or exposed welds on unpolished surfaces to be background to surface of original metal to remove all impurities from welds. Solder is not permissible unless specifically specified and approved. Make all welds smooth, with neither dip nor bulge.

2.16 DESIGN & CONSTRUCTION

A. All visible seams to be continuously Tig or Meg welded and polished to match adjacent surfaces.

B. All visible seams to be free of pits, flaw and ground smooth and polished to a #4 finish.

C. The "grain" direction of horizontal stainless steel surface is longitudinal, including splash. The polishing procedures at right angle corners of units shall provide for a mitered appearance.

D. All hidden weld joints shall be painted "gray".

2.17 REFRIGERATION

A. Furnish and install and thoroughly test all refrigeration systems furnished as part of the foodservice equipment under this section and as specified under the itemized specifications. Provide refrigeration system complete with components required for operation, designed for direct expansion, employing thermostatic expansion valves and pressure switches.

B. Rate compressors on the American Society of Refrigeration Engineers Standards, based on a maximum operating time of 16 hours per day on 100 degree F. days. Mount compressor, condenser, motor and auxiliary equipment on a single rigid base. Automatically control each unit by a suction pressure switch and a high pressure cut-off. Provide relief lines required by codes, capped with screen vent fittings. Hermetically sealed must be serviceable in the field.

C. Refrigerant, drain piping shall be Type L hard drawn seamless copper tubing, with silver soldered joints. All refrigerant suction lines outside of the Walk-in Boxes shall be insulated with 3/4" flexible closed cell foam insulation, applied in accordance with the manufacturers recommendations. All condensate drain lines inside Walk-in Boxes shall be similarly insulated with 1/2" insulation. Each refrigerant system shall include a dehydrator, liquid line sight glass, shut-off valve, liquid line solenoid, thermostatic expansion valve at each evaporator, vibration isolator, and other fittings and accessories as required. Refrigerant lines shall extend vertically from condensing unit to above the hung ceiling, then horizontally to above the evaporators, then piped in accordance with manufacturers instructions and good practice as set forth in ASHRAE Guide and Data Book. All work to be done in a workmanlike manner.

D. Provide evaporator coil defrost system on all walk-in refrigerator and freezer rooms where the refrigeration systems are designed to operate at room temperature of less than 35˚F.

E. Verify the requirements of and provide any or all additional refrigeration components required or recommended by the manufacturer for proper operation under specific operating conditions and location of each system specified.

F. All refrigeration equipment items shall utilize CFC Free components or the latest technology available at the purchase date from the manufacturer.

G. Proper ventilation of "built-in" refrigeration components shall be provided with cut-outs, ventilation panels of other means to protect the equipment from excessive heat build-up damage of warranty violation.

PART 3 - EXECUTION

3.01 COORDINATION OF WORK

A. Kitchen Equipment Contractor shall submit to and coordinate any and all work schedules respective to this contract with the Owner, participate in required scheduling meetings and co-sign the schedule agreed to by the Prime Contractors.

A. Field inspect conditions at site and verify that the wall dimensions and rough ins were properly installed. Notify the Architect in writing of discrepancies between the contract documents and the actual conditions on the jobsite prior to equipment fabrication. Check all door openings, passageways, elevators, etc., to be sure that equipment can be conveyed into its proper location within the building and, if necessary, check with the contractor regarding the possibility of holding wall erection, placement of doorjambs, windows, etc. for the purpose of moving the equipment into its proper location.

B. Kitchen Equipment Contractor shall provide a competent foreman or superintendent to supervise the installation of equipment furnished by this contractor. The Superintendent shall coordinate all information necessary for the satisfactory execution and timely installation of the kitchen equipment with all other trades.

D. Slots, chases, openings, and recesses through walls, floors, ceilings, and roofs in construction shall be provided by the various trades in respect to their materials.

E. Locations of pipes, conduits, ducts, panels, equipment, fixtures, etc., shall be adjusted to accommodate the work as to interference anticipated or encountered. Kitchen Equipment Contractor shall determine the exact route and location of each pipe, conduit, and duct prior to fabrication.

F. Kitchen Equipment Contractor shall provide all necessary access panels in equipment, duct, etc., as required for inspection of interiors, cleaning and for proper maintenance. Panels shall be made of matching material and removable without the use of tools.

G. Kitchen Equipment Contractor shall coordinate requirements for wall reinforcement and special support locations.

3.02 INSTALLATION REQUIREMENTS AND CLEARANCES

A. Installation of the foodservice equipment shall be by the Kitchen Equipment Contractor and installed level and plumb, according to manufacturers written instructions, original design and referenced standards.

B. Layout the work and establish all heights and grades required for installation.

C. Deliver foodservice equipment as factory-assembled units with protective crating and covering.

D. Store foodservice equipment in original protective crating and covering and in a dry location. Immediately repair or replace damaged or lost equipment.

E. Equipment that butts to a wall or against other equipment shall be sealed with General Electric "Silastic" or Dow Corning 732 RTV sealant. Joints exceeding 3/8" in width shall be trimmed

with stainless steel channel and caulk with sealant.

F. Assist in moving equipment so other trades can make connections and be on the job to level and adjust equipment as the last connection is made. During installation instruct the trades on hook up of the various items of equipment.

3.03 OPENINGS

A. Openings in walls, floors, and other construction to receive pipe lines, risers, duct work and other equipment shall be provided by other trades. All openings shall be drilled, core bored or cut in a manner satisfactory to and at all locations and time approved by the Architect. Materials damaged under this contract shall be patched or replaced as directed by the Architect.

3.04 CUTTING, PATCHING AND RESTORING

A. Under each of the specifications, Architectural Trades shall be responsible for all required digging, cutting, backfilling, patching, etc., incident to its work under that section, and shall make all required repairs thereafter to the satisfaction of other trades.

3.05 PAINTING

A. Each trade shall be responsible for painting all material and no equipment items provided without a factory finish. Factory finishes include painted, galvanized, aluminum, stainless steel and plated or polished non-corrosive surfaces.

B. A prime coat plus two finish coats of vinyl base paint shall be provided on items to be field painted. Painting shall be in accordance with manufacturer's recommendations, with color approved by Project Coordinator.

3.06 INSTRUCTION AND OPERATING MAINTENANCE MANUALS

A. Three (3) complete copies of the Maintenance Manual labeled as described herein shall be submitted to Architect for approval. The manuals shall be spiral bound. The copies shall be submitted a minimum of two weeks prior to any instructions or demonstrations to Owner's personnel.

B. The manuals shall be typewritten and include a table of contents. The information shall be arranged in logical order for use by the Owner's personnel in maintaining the completed project.

C. The Manuals shall include, but not be limited to the following:
   1. Table of Contents (denoting item, manufacturer, model number and serial number)
   2. Name and phone number of applicable service agencies for equipment furnished.
   3. Materials list with place of purchase.
   4. List of normally replace items, such as filters, fuses, belts, seals, screens, etc., indicating style, rating, size, etc., and place of purchase.
   5. Installation, servicing, maintenance and operating instructions for all systems and components with place of original purchase, and name, address and phone number of person servicing system.

6. Manufacturers' guarantees and warranties.
7. Approved copies of shop drawing, including component wiring diagrams and ATV wiring piping diagrams of all installed systems indicating all connections, color coding, functions, locations, parts lists, etc. "Approved as noted" shop drawing submittal shall be corrected to incorporate all approval notes prior to inclusion in maintenance manuals.

3.07 CLEANING

A. Food Service Equipment Contractor to leave the area, "Construction Clean", remove any temporary protection from equipment and ready for use. Final cleaning and Sanitizing to be the responsibility of the Owner/Operator.

B. Crating, boxes, coverings and trash pertaining to this equipment to be removed daily.

3.08 INSTRUCTION/DEMONSTRATION

A. Maintenance Manuals
   1. Instruction manuals shall be furnished a minimum of two weeks prior to any instructions or demonstrations to Owner's personnel.

B. Instructions to Owner's Personnel

   1. At the completion of the work, Contractor shall instruct and demonstrate to those Architect employees who will have charge of the equipment, the care, adjustment, and operation of all parts of the system.
   2. After instructions, prepare a letter stating that the equipment was demonstrated and personally checked by the manufacturer's representative and found to be operating properly. Acceptance of the installation will not be completed until the letter, signed by the Owner, is received.
   3. A representative of the supplier of the kitchen equipment must be present in the kitchen during the demonstration by the appropriate equipment manufacturer.

PART 4 – SCHEDULE OF EQUIPMENT

4.01 ITEMIZED EQUIPMENT SPECIFICATION

A. The following equipment schedule/specifications refers to various items of food service equipment shown on the Contract Drawings. The Contract Drawings and notes form a part of these specifications and shall be as binding as if written herein.

ITEM BAR1 - BAR TOP / BAR WALL (1 REQ'D)
NIKEC - BY GC / MILLWORK SUBCONTRACTOR

ITEM BAR2 - WORK TABLE, STAINLESS STEEL TOP (1 REQ'D)
Advance Tabco Model SLAG-182-X
Special Value Work Table, 24"W x 18"D, 16 gauge 430 stainless steel top, 18 gauge adjustable stainless steel undershelf, stainless steel legs & adjustable bullet feet, NSF

ITEM BAR3 - UNDERBAR SINK UNITS (1 REQ'D)
Perlick Corporation Model TS53C
TS Series Underbar Sink Unit, three compartment, 60"W x 18-9/16"D, 6"H backsplash, 10" wide x 14" front-to-back x 9-1/4" deep compartments, 12" embossed drainboards on left & right, 4" OC splash mount faucet holes, apron on front & sides, sound-deadened underside, includes 1-1/2" drains & 8-1/2" removable overflow standpipes, stainless steel construction, stainless steel legs with adjustable thermoplastic feet, NSF

1 ea 6" Backsplash standard
1 ea Model 934-10LF Front Loading Faucet, wall/splash mount, lead free, 10" swing spout, faucet valves include built-in check valves to prevent back flow or cross flow, (2) 3/8" O.D. x 3/8" O.D. x 18" braided stainless steel supply lines included

ITEM BAR3.1 - FAUCET (1 REQ'D)
INCLUDED WITH ITEM #BAR3

ITEM BAR4 - TRASH RECEPTACLE, INDOOR (3 REQ'D)
Rubbermaid Commercial Products Model FG354060GRAY
Slim Jim® Container, 23 gallon, 22"W x 11"D x 30"H, with venting channels, molded-in handles, general purpose waste, open type without lid, high-impact plastic construction, gray, Made in USA

ITEM BAR5 - HAND SINK (1 REQ'D)
Perlick Corporation Model TS12HSN
TS Series Underbar Hand Sink Unit, free standing, 12"W x 22-1/4"D, 6" backsplash, 10" wide x 14" front-to-back x 9-1/4" deep sink, 4" OC splash mount faucet holes, 16 oz. pump soap dispenser, C-fold paper towel dispenser on front apron, sound-deadened underside, (1) 8-1/2" standpipe, 1-1/2" NPS male drain, stainless steel construction, stainless steel legs with adjustable thermoplastic feet, NSF

1 ea Model 934GN-LF Front Loading Faucet, wall/splash mount, lead free, gooseneck spout, faucet valves includes: built-in check valves to prevent back flow or across flow, (2) 3/8" O.D. x 3/8" O.D. x 18", braided stainless steel supply lines included

ITEM BAR5.1 - FAUCET (1 REQ'D)
INCLUDED WITH ITEM #BAR5

ITEM BAR6 - BOTTLE STORAGE UNIT (1 REQ'D)
Perlick Corporation Model TS12LS
TS Series Underbar Liquor Bottle Step Display, 12"W x 24"D, 3"H steps, stainless steel construction, stainless steel legs with adjustable thermoplastic feet, NSF

1 ea 6" Backsplash standard
1 ea Model BG12 Bottle Guardrail Set, for TS12LS

ITEM BAR7 - SODA GUN FILLER SECTION (1 REQ'D)
Perlick Corporation Model TS6SGB
TS Series Soda Gun Filler Section, 6"W x 18-9/16"D x 22"H, all stainless steel construction, universal design accepts either Wunder-Bar® & Schroeder America™ 8-14 product soda manifolds & drip cups, interior mounted manifold conceals soda lines, tool-less removal of top cover provides easy access, integrated drip cup mounting allows concealed routing of drip tube to waste drain, accessory speed rails can bypass or terminate on Soda Gun Filler, soda manifold, hose gun & drip cup NOT included, NSF

ITEM BAR8 - ICE BIN (1 REQ'D)
Perlick Corporation Model TS36IC
TS Series Underbar Ice Bin/Cocktail Unit, modular, 36"W x 18-9/16"D, approximately 85-lb. ice capacity, 6"H backsplash with 1" return at top, ABS plastic top ledge, 10-3/4" deep stainless steel ice bin, stainless steel front & sides, galvanized steel back & bottom, 1/2" NPS male drain, 1-5/8" tubular stainless steel legs with 1" adjustable thermoplastic feet, NSF

1 ea 6" Backsplash standard
1 ea Model BW6-36 Underbar Bottle Well with Ice Chest Cover Assembly, 6-bottle capacity, 2-piece stainless steel sliding cover assembly, (3) black polypropylene bottle wells on each side (for TS36, TSD36, & TSS36 ice chests)
1 ea Model SR-S36A Speed Rail, single, 36" W, stainless steel construction, factory installed
1 ea Model SRLC-S36 Locking Speed Rail Cover, single, 36" W, stainless steel construction, factory installed (cover only)

ITEM BAR9 - GLASS RACK (1 REQ'D)

Perlick Corporation Model 7055A-D
Underbar Glass Rack Storage Unit, drainboard top, 24"W x 24"D open front cabinet base, holds (2) 20" x 20" glass racks, 6"H backsplash, (2) stationary rack slides height adjustable in 1" increments, embossed drainboard is reinforced & includes 1/2" drain at rear, 1-1/2" drain in bottom shelf, stainless steel construction, stainless steel legs & adjustable feet

1 ea 6" Backsplash standard

ITEM BAR10 - DRAFT BEER COOLER (1 REQ'D)
Perlick Corporation Model DDS84
Direct Draw Draft Beer Dispenser, three-section, 84"W, self-contained refrigeration, holds (4) half barrels (LESS TAPPING), 33-40°F temperature range, (3) solid doors, digital thermostat, front vented, automatic defrost & evaporator condensate, automatic defrost & condensate evaporator, includes floor drain, stainless steel top, ends & back exterior, 1/4 HP, R290 Hydrocarbon refrigerant, NSF, cULus

1 ea WARNING: The materials used in this product may contain chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov
1 ea 120v/60/1-ph, 4.2 amps, NEMA 5-15P
1 ea 5 yr. compressor warranty, 1 yr. parts & labor warranty
1 ea Condensing unit location: Left
1 ea Condensing unit cover finish: Black vinyl coated
1 ea Door type, first: solid, black vinyl clad
1 ea Door hinge location, first: Left
1 ea Door type, second: solid, black vinyl clad
1 ea Door hinge location, second: Left
1 ea Door type, third: solid, black vinyl clad
1 ea Door hinge location, third: Right
1 ea Stainless Steel - Draft Arm Top
1 ea Model 69526-3DA Draft Arm Style Beer Dispensing Kit - (3) Faucets, Chrome, above SECOND DOOR (dispensing head, drainer, faucet(s), air distributors, beer line connectors, air hose, air distributor cover, beer & drain line covers, air scoop & tubing, air sleeve, spanner wrench, drainer tubing - 8', silicone, hardware & fittings, field installation kit) (NOTE: keg couplers sold separately)
1 ea Note: Keg coupler not included in beer dispensing kits; must be ordered separately. Refer to the Perlick tapping price book or perlick.com
1 ea Model 69526-3DA Draft Arm Style Beer Dispensing Kit - (3) Faucets, Chrome, above THIRD DOOR (dispensing head, drainer, faucet(s), air distributors, beer line connectors, air hose, air distributor cover, beer & drain line covers, air scoop & tubing, air

sleeve, spanner wrench, drainer tubing - 8', silicone, hardware & fittings, field installation kit) (NOTE: keg couplers sold separately)
1 ea Note: Keg coupler not included in beer dispensing kits; must be ordered separately. Refer to the Perlick tapping price book or perlick.com
2 ea Model 2928F Primary regulator for CO2, twin gauge (Replaces 2922F)
1 ea No legs or casters

ITEM BAR11 - SPARE NUMBER

ITEM BAR12 - SPARE NUMBER

ITEM BAR13 - BACK BAR CABINET, REFRIGERATED (1 REQ'D)
Perlick Corporation Model BBS60
Refrigerated Back Bar Cabinet, two-section, 60"W, self-contained refrigeration, 16 cu.ft. internal volume, digital thermostat, LED interior lighting, front vented, automatic defrost & condensate evaporator, includes floor drain, stainless steel interior, side mount compressor, 1/5 HP, R290 Hydrocarbon refrigerant, NSF, cULus

1 ea WARNING: The materials used in this product may contain chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov
1 ea 120v/60/1-ph, 2.5 amps, NEMA 5-15P
1 ea 5 yr. compressor warranty, 1 yr. parts & labor warranty
1 ea Standard refrigerator
1 ea Stainless steel top - no tapping holes
1 ea Condensing unit location: Right
1 ea Condensing unit cover finish: Black vinyl coated
1 ea End finish: Stainless steel, unfinished, both sides, standard
1 ea Door type, first: solid, black vinyl/field laminated
1 ea Door hinge location, first: Left
1 ea Door handle, first: full length stainless steel handle, 24"
1 ea Shelving style, first: (3) flat shelves
1 ea Door type, second: solid, black vinyl/field laminated
1 ea Door hinge location, second: Right
1 ea Door handle, second: full length stainless steel handle, 24"
1 ea Shelving style, second: (3) flat shelves
1 ea Crisp White™ LED
1 st No legs or casters

ITEM BAR14 - BOTTLE COOLER (1 REQ'D)
Perlick Corporation Model BC72LT-3
Bottle Cooler, flat top, low temperature, 72" W, self-contained refrigeration, (20.3) cu. ft. interior capacity, digital temperature control & display, 30°F factory temperature setting, (2) dent-resist and stainless steel doors with lock & die-cast handle, automatic condensate evaporator, automatic defrost, stainless steel top & interior, R290 Hydrocarbon refrigerant, 1/4 HP, 120v/60/1-ph, 4.4 amps, NEMA 5-15P, NSF, cULus

1 ea WARNING: The materials used in this product may contain chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov
1 ea 5 yr. compressor warranty, 1 yr. parts & labor warranty
1 ea Black cabinet finish
1 ea (4) bin dividers with supporting brackets
1 ea Model 63771A-2 Low Profile Rollers, 1-5/8", set of (6)

ITEM BAR15 - BACK BAR CABINET, REFRIGERATED (1 REQ'D)
Perlick Corporation Model BBS36
Refrigerated Back Bar Cabinet, one-section, 36"W, self-contained refrigeration, 7.4 cu.ft. internal volume, digital thermostat, LED interior lighting, front vented, automatic defrost & condensate evaporator, includes floor drain, stainless steel interior, side mount compressor, 1/6 HP, R290 Hydrocarbon refrigerant, NSF, cULus

1 ea WARNING: The materials used in this product may contain chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov
1 ea 120v/60/1-ph, 1.8 amps, NEMA 5-15P
1 ea 5 yr. compressor warranty, 1 yr. parts & labor warranty
1 ea Standard refrigerator
1 ea Stainless steel top - no tapping holes
1 ea Condensing unit location: Left
1 ea Condensing unit cover finish: Black vinyl coated
1 ea End finish: Stainless steel, unfinished, both sides, standard
1 ea Door type: solid, black vinyl/field laminated
1 ea Door hinge location: Left
1 ea Door handle: full length stainless steel handle, 24"
1 ea Shelving style: (3) flat shelves
1 ea Crisp White™ LED
1 ea No legs or casters

ITEM BAR16 - BACK BAR TOP / CABINETS (1 REQ'D)
NIKEC - BY GC / MILLWORK SUBCONTRACTOR

ITEM GEC1 - HD RANGE, 36", 6 COIL BURNERS (1 REQ'D)
Garland/US Range Model 36ER33
36E Series Heavy Duty Range, electric, 36", (6) coil elements, standard oven, 4-position rack glides, (1) rack, 3" high vent riser, stainless steel front, sides & front rail, 6" legs, 19.1kW, cCSAus, NSF (Garland)

1 ea One year limited parts and labor warranty, covers products purchased and installed in the USA only, standard
1 ea 208v/60/3-ph, 62 amps
1 ea Swivel Casters, Polyurethane wheels (non-marking)

ITEM GEC2 - HD RANGE, 36" THERMOSTATIC GRIDDLE (1 REQ'D)
Garland/US Range Model 36ER38
36E Series Heavy Duty Range, electric, 36", griddle, thermostatic controls, standard oven, 4-position rack glides, (1) rack, 3" high vent riser, stainless steel front, sides & front rail, 6" legs, 21.5kW, cCSAus, NSF (Garland)

1 ea One year limited parts and labor warranty, covers products purchased and installed in the USA only, standard
1 ea 460v/60/3-ph, 31 amps
1 ea Swivel Casters, Polyurethane wheels (non-marking)

ITEM GEC3 - CHARBROILER, ELECTRIC, COUNTERTOP (1 REQ'D)
Garland/US Range Model ED-30B
Designer Series Charbroiler, electric, 30" x 17-1/4" cooking area countertop, grate lift handle, infinite controls, grease drawer, stainless steel front and sides, 4" legs, 5.4 kW, NSF, CSA, CE (Garland)

1 ea One year limited parts and labor warranty, covers products purchased and installed in the USA only, standard
1 ea 208v/60/3-ph, 23 amps, direct
1 ea Stainless steel main back and bottom
1 ea Splatterguard

ITEM GEC4 - EQUIPMENT STAND, REFRIGERATED BASE (1 REQ'D)
Victory Refrigeration Model CBR52HC
Chef Base Refrigerator, one-section, 52"W, self-contained, 9.58 cu. ft. capacity, (2) drawers (upper drawer accommodates (3) 12" x 20" x 6" pans per drawer & lower drawer accommodates (3) 12" x 20" x 6" pans per drawer - not included), full electronic control, stainless steel exterior (galvanized back & bottom), aluminum interior, magnetic gaskets with 2 year warranty, side mounted self-contained refrigeration system, R290

hydrocarbon refrigerant, 1/6 HP, cULus, UL EPH Classified, UL-Sanitation, MADE IN USA

1 ea 3 years parts & labor warranty (excludes maintenance items)
1 ea Self-Contained refrigeration
1 ea Additional 4 year compressor warranty (part only), standard
1 ea 115v/60/1-ph, 1.7 amps, cord with NEMA 5-15P
1 ea Compressor located on right, standard
1 ea Marine edge, standard
1 st Model 00C31S073A 3" Casters, plate (2 braked), for WTFCS & WTRCS series (set of 4), standard

ITEM GEC5 - FOOD PAN WARMER, COUNTERTOP (1 REQ'D)
Hatco Model HW-FUL
Food Warmer, electric, countertop, (1) 1/1 pan capacity, wet/dry operation, thermostatic controls, stainless steel construction, 1200 watts, 10.0 amps, CE, cULus, UL EPH Classified

1 ea NOTE: Sale of this product must comply with Hatco's Minimum Resale Price Policy; consult order acknowledgement for details
1 ea NOTE: Includes 24/7 parts & service assistance, call 414-671-6350
1 ea One year parts & labor warranty, standard
1 ea 120v/60/1-ph, 1200 watts, 10.0 amps, NEMA 5-15P (domestic voltage), standard

ITEM GEC6 - ELECTRIC FRYER, BATTERY (1 REQ'D)
Frymaster Model FPRE217
Fryer Battery, electric, hi-efficiency, (2) 50 lb. capacity each, built-in filtration, open frypot design, automatic melt cycle, boil out temperature control, temperature probe, includes: rack-type basket support, basket hanger & twin baskets, stainless steel frypots, doors, & cabinets, (2) 17 kW, cULus, NSF, TUV, ENERGY STAR®, Enerlogic®

1 ea Note: Prices listed are for within the USA only. Please contact the factory for pricing if quoting outside of the USA
2 ea (2) 480v/50/60/3-ph, 21.0 amps, 17.0 kW, 3 wire plus ground, cord
1 ea 120v/60/1-ph, 8 amps, cord & plug
1 ea Digital Timer controller, in lieu of standard
1 ea Full frypots, standard
2 ea Model 823-9414 Frypot Cover, full pot, 14-5/8 x 19-3/8" D, stainless steel (RE14, RE17, RE22, RE14TC, RE17TC, RE22TC, SR114E, 1814E)
2 ea Model 803-0358 Sediment Tray, full pot, 10-1/2" x 11-5/8" x 4" (RE14, RE17, RE22, RE14TC, RE17TC, RE22TC)
1 ea Spreader cabinet, stainless steel door and cabinet
1 ea Solid Flat Top, standard

1 ea	Model FWH-1 Food Warmer & Holding Station, ceramic heating element with wire guard, radiant heat, includes; heat lamp, cord & plug, 12 x 20 x 2-1/2" stainless steel cafeteria-style pan & screen (additional cabinet required), NSF, cULus
1 ea	120v/60/1-ph, 6.3 amps, standard, for heat lamp
1 ea	Model 803-0002 Filter Powder, box of 80, 1 ounce packs
1 bx	Model 803-0170 Filter Paper, 19-1/2" x 27-1/2", box of 100 sheets, for Footprint Filter systems
1 ea	Casters (set of 4), standard
1 ea	Model CDC50 Cleaning Solution Caddy, 6.6 gallons (25 liters) water capacity, latching stainless steel lid, fold-down handle, drain valve, stainless steel pan, 2" low profile casters, 1/2" drain pipe & shut-off valve
1 ea	Start-Up Program, included at Customer's request on all fryers with built-in filter
1 ea	Start-Up Program includes gas pressure check, boil out of all frypots, gas plumbing size, wiring inspection, proper basket lift operation, cleaning of all frypots with damp rag/paper towels, controller check & programming demonstration, inspection of vent hood & demonstration of the proper use & care of the filter sys (if all is applicable)

ITEM GEC6.1 -HEATED FRY DUMP (1 REQ'D)
INCLUDED WITH ITEM #GEC6

ITEM GEC7 - EXHAUST HOOD (1 REQ'D)
Captive-Aire

Hood #1 - Job #6134597

1 ea	5424ND-2-PSP-F - 14ft 6" Long Exhaust-Only Wall Canopy Hood with 16" Wide Front Perforated Supply Plenum with Built-in 3" Back Standoff
1 ea	430 SS Where Exposed
1 ea	Fire Cabinet on the Right Side 12.00" Width x 54.00" Length x 24.00" Height (Additional charges may apply for cabinet if not sold with fire system)
10 ea	FILTER - 20" tall x 16" (19.625" by 15.625") wide Stainless Steel Captrate Solo filter with hook, ETL Listed. Particulate capture efficiency: 85% efficient at 9 microns, 76% efficient at 5 microns. Used on hoods shipped AFTER 7/27/17.
5 ea	L55 Series E26 Canopy Light Fixture - High Temp Assembly, Includes Clear Thermal and Shock Resistant Globe (L55 Fixture), Bulbs By Others
5 ea	Extra Fixtures- L55 Series E26 Canopy Light Fixture - High Temp Assembly, Includes Clear Thermal and Shock Resistant Globe (L55 Fixture)

1 ea EXHAUST RISER - Factory installed 18" Diameter X 4" Height
4 ea SUPPLY RISER - 12"x 28" Supply Riser with Volume Dampers
2 ea 1/2 Pint Grease Cup New Style, Flanged Slotted
1 ea FIELD WRAPPER 18.00" High Front, Left, Right
1 ea BACK STANDOFF (FLAT) 12" Wide 186" Long
1 ea INSULATION FOR TOP OF HOOD
1 ea INSULATION FOR BACK OF HOOD

Electrical System #1 - Job #6134597
1 ea SC-311110MA 3 Phase w/ control for 1 Exhaust Fan, 1 Supply Fan, Exhaust on in Fire, Lights out in Fire, Relay On/Off with Supply Fan, Fan(s) On/Off Thermostatically Controlled. Room temperature sensor shipped loose for field installation. INVERTER DUTY 3 PHASE MOTOR REQUIRED FOR USE WITH VFD. Includes 1 Duct Thermostat kit.
1 ea ESV402N02TXB571 - Variable Frequency Drive - 5 HP Max., 200/240 V, Three Phase, 16.5 A Max., NEMA 1 Enclosure, with 2RJ-45 FOR MODBUS
1 ea ESV402N02TXB571 - Variable Frequency Drive - 5 HP Max., 200/240 V, Three Phase, 16.5 A Max., NEMA 1 Enclosure, with 2RJ-45 FOR MODBUS
1 ea 20 wide X18 tall X8.62 deep SS HINGED ELECTRICAL BOX NEMA 1 - VENTED. Stainless plate instead of filter assembly.
1 ea Digital Prewire Lighting Relay Kit. Includes hood lighting relay & terminal blocks. Allows for up to 1400W of lighting each.
1 ea CAT-5E CABLE - 50 Foot. UV rated. x1

ITEM GEC7.1 -FIRE SUPPRESSION SYSTEM (1 REQ'D)
Captive-Aire

Fire System #1 - Job #6134597
1 ea TANK-SP-3 Tank Fire Suppression 12 gallon Fire System in Utility Cabinet (includes pre-piped hood(s) with electric detection, tank(s), 24 VDC release mechanism, fire system agent, pressurized tanks, and electric pull station). (Formerly CAS-EWC).
Includes piping for hood: 1.
1 ea Tank-based Fire Protection System equipped with Electronic Detection utilizing CORE board as a Listed Release Mechanism. Installed in Hood Utility Cabinet separate from prewire. Includes 12" box housing circuit board, batteries, and terminals for connection to main control panel.
1 ea Pressure Switch - Monitors Tank Pressure, Supervised Signal, TANK FIRE SUPPRESSION

ITEM GEC7.2 -UTILITY DISTRIBUTION SYSTEM (1 REQ'D)
Captive-Aire

UDS #1 - Job #6134878

ITEM GEC7.3 -EXHAUST FAN (1 REQ'D)
By Others
NIKEC - PROVIDED BY THE MECHANICAL CONTRACTOR

ITEM GEC7.4 -SUPPLY FAN (1 REQ'D)
By Others
NIKEC - PROVIDED BY THE MECHANICAL CONTRACTOR

ITEM GEC8 - REACH-IN FREEZER (1 REQ'D)
Victory Refrigeration Model FS-1D-S1-EW-HC
UltraSpec™ Series Freezer, Reach-in, one-section, self-contained refrigeration, 24.08 cu. ft. capacity, (1) wide full height solid hinged door, (3) silver freeze (chrome-style) shelves, stainless exterior & interior, standard depth cabinet, TOUCH POINT™ electronic temperature control/indicator, LED lighting, expansion valve technology, Santoprene door gaskets with 2 year warranty, stainless steel breakers, R290 Hydrocarbon refrigerant, 3/4 HP, cULus, UL EPH Classified, UL-Sanitation, MADE IN USA

1 ea	3 years parts & labor warranty (excludes maintenance items)
1 ea	Self-Contained refrigeration
1 ea	Additional 4 year compressor warranty (part only), standard
1 ea	115v/60/1-ph, 9.1 amps, with cord & NEMA 5-15P
1 ea	Door hinging: standard on right
1 ea	6" Casters, in lieu of standard 6" stainless steel legs, no charge when specified on order

ITEM GEC9 - HEATED HOLDING CABINET (2 REQ'D)
NIKEC - PROVIDED BY OWNER

ITEM GEC10 - S.S. WALL PANEL (1 REQ'D)
Custom fabricated 48" wide x 60" high 18 ga. stainless steel wall panel. Provide cap strips as required.

ITEM GEC11 - SPARE NUMBER

ITEM GEC12 - BUN / SHEET PAN RACK (1 REQ'D)
Metro Model RD78N

Pan Rack, mobile, pass-thru, 24-3/8"W , 69 1/2"H, 26"D, open sides, with slides for (13) 18" x 26" pans, slides on 4-1/2" centers, riveted angle-type aluminum frame, with 5" swivel casters (2 with brakes), NSF

1 ea Model A33 Continuous Bumper, gray

ITEM GEC13 - RAPID COOK OVEN (1 REQ'D)
Merrychef USA Model E4S
eikon™ Convection, Air Impingement and Microwave Speed Oven, ventless cooking capability, quiet operation, EasyTouch™ controls, USB memory, built-in diagnostic testing, bottom-hinged door, includes: (1) wire rack "DV0908", (1) paddle "PSR310", (2) mesh bottom baskets "32Z4031", (1) cool down pan "32Z4028" & (1) cleaner kit "32Z4148", stainless steel construction, 6.2kW, 208/240v/60/1-ph, 30 amp, NEMA 6-30P, CE, cULus, NSF, ETL

1 ea 1 year parts & labor warranty, standard
Designer to confirm with Operator which Pans, Paddles & Baskets are desired for the operation and menu items

ITEM GEC14 - UNDERCOUNTER REFRIGERATOR (1 REQ'D)
Victory Refrigeration Model VUR60HC
Undercounter Refrigerator, two-section, 60"W, rear mounted self-contained refrigeration, 14.75 cubic feet capacity, (2) self-closing doors, (4) epoxy coated wire shelves, full electronic control, 1/2" thick stainless steel top, stainless steel door, front & sides, aluminum interior, Santoprene gaskets with 2 year warranty, R290 Hydrocarbon refrigerant, 1/5 HP, UL-Sanitation, cULus, UL EPH Classified, MADE IN USA

1 ea 3 years parts & labor warranty (excludes maintenance items)
1 ea Self-Contained refrigeration
1 ea Additional 4 year compressor warranty (part only), standard
1 ea 115v/60/1-ph, 3.0 amps, with cord & NEMA 5-15P
1 ea Door hinging: left door hinged on left, right door hinged on right standard
1 ea Casters, set of (4), 6" high, (2) with brakes, standard

ITEM GEC15 - CONVEYOR TOASTER (1 REQ'D)
Hatco Model TQ-400
Toast-Qwik® Conveyor Toaster, horizontal conveyor, countertop design, all bread types toaster, approximately 6 slice capacity/min, 2" opening height, rotary mechanical controls, ColorGuard sensing system, CE, cULus, UL EPH Classified, Made in USA

1 ea NOTE: Sale of this product must comply with Hatco's Minimum Resale Price Policy; consult order acknowledgement for details
1 ea NOTE: Includes 24/7 parts & service assistance, call 414-671-6350
1 ea One year on-site parts & labor warranty, plus one additional year parts only warranty on all Toast-Qwik metal sheathed elements
1 ea 120v/60/1-ph, 1790 watts, 14.9 amps, NEMA 5-15P (domestic voltage), standard

ITEM GEC16 - SANDWICH / SALAD PREPARATION REFRIGERATOR (1 REQ'D)
Victory Refrigeration Model VSPD72HC-18-2
UltraSpec™ Series Sandwich Prep Table, three-section, 72"W, self-contained, 20.0 cubic feet capacity, (2) self-closing doors, (4) epoxy coated shelves, (2) drawers (upper drawer accommodates (2) 4" deep pans & lower drawer accommodates (2) 6" deep pans - not included), stainless top with opening for (18) 1/6 size pans, 10" cutting board constructed of white polyethylene plastic, locking divider bars, hinged, insulated flat lift-up lid, full electronic control, stainless steel door, front, & sides, aluminum interior, Santoprene gaskets with 2 year warranty, rear mount refrigeration system, R290 Hydrocarbon refrigerant, 1/3 HP, cULus, UL EPH Classified, UL-Sanitation, MADE IN USA

1 ea 3 years parts & labor warranty (excludes maintenance items)
1 ea Self-Contained refrigeration
1 ea Additional 4 year compressor warranty (part only), standard
1 ea 115v/60/1-ph, 5.4 amps, cord, NEMA 5-15P
1 ea Door hinging: left door hinged on left, right door hinged on right standard
1 ea Casters, set of (4), 6" high, (2) with brakes, standard (legs are standard on remote units)

ITEM GEC17 - WORK TABLE, STAINLESS STEEL TOP (1 REQ'D)
Advance Tabco Model SS-304
Work Table, 48"W x 30"D, 14 gauge 304 stainless steel top, 18 gauge adjustable stainless steel undershelf, stainless steel legs & adjustable bullet feet, NSF

ITEM GEC18 - HEAT LAMP (2 REQ'D)
Hatco Model DL775RTLBB-BK.1
(QUICK SHIP MODEL) DL-775-RTL Decorative Heat Lamp, bold black, 8-1/2"H x 10-1/2" diameter shade, includes: black cord, black track adapter, lower switch & coated bulb, 120v/60/1-ph, 250 watt max, cULus, UL EPH Classified

2 ea NOTE: Sale of this product must comply with Hatco's Minimum Resale Price Policy; consult order acknowledgement for details

2 ea NOTE: Includes 24/7 parts & service assistance, call 414-671-6350
2 ea Contact factory for parts & labor warranty
2 ea NOTE: Your order will be shipped the same day if you place it before 12 noon Central Standard Time, or the next business day if ordered after 12 noon. All orders are subject to credit approval.
1 ea Model DL-TRACK-4B Track Mount Bar, 4', black

ITEM GEP1 - WORK TABLE, STAINLESS STEEL TOP (1 REQ'D)
Advance Tabco Model TKSS-3010
Work Table, 120"W x 30"D, 14 gauge 304 stainless steel top with 5"H backsplash, stainless steel legs with side & rear crossrails, adjustable stainless steel bullet feet, NSF

2 ea Model US-30-30 Work Table Undershelf, for work tables 30"W x 30"D, 18 gauge stainless steel, NSF (actual shelf is 6" shorter than table width & depth) (suggested maximum load 300 pounds distributed weight)
1 ea Model TA-20-PAIR (2) Stainless Steel Legs , 34 1/2"H, with stainless steel adjustable bullet feet
1 ea Weld-In sink - double bowl
1 ea Model TA-11D-2 Double Sink Welded Into Table Top, 20"W x 20"D x 12" deep bowls, includes faucet, NSF (must specify sink location)
2 ea Model SHD-2020 Drawer, 20"W x 20"D x 5" deep drawer pan insert, heavy duty, self-closing, stainless steel, NSF

ITEM GEP1.1 - FAUCET (1 REQ'D)
INCLUDED WITH ITEM #GEP1

ITEM GEP2 - OVERSHELF (1 REQ'D)
Advance Tabco Model PS-12-120
Shelf with Pot Rack, wall-mounted, 120"W x 12"D, 18/430 stainless steel shelf, 2" x 1/4" stainless steel pot rack, includes: (9) plated double pot hooks (units 96" & longer have (3) support brackets), NSF

ITEM GEP3 - FOOD PROCESSOR, BENCHTOP / COUNTERTOP (1 REQ'D)
Robot Coupe Model CL50EULTRA
Commercial Food Processor, includes: vegetable prep attachment with kidney shaped & cylindrical hopper (no bowl), (1) 3mm grating disc (28058), (1) 3mm slicing disc (28064), 2-disc rack, stainless steel motor base, single speed 425 RPM, 1-1/2 HP, 120v/60/1-ph, 12.0 amps, NEMA 5-15P, cETLus, ETL-Sanitation

1 ea 1 year parts & labor warranty

1 ea Model 107812 Disc Holder, wall mount, (4) stainless steel pegs, holds (16) small discs or (8) large discs

ITEM GEP4 - HAND SINK (2 REQ'D)
Advance Tabco Model 7-PS-23-EC-SP-X
Special Value Hand Sink with 7 3/4" side splashes, wall model, 9" wide x 9" front-to-back x 5" deep bowl, 20 gauge 304 stainless steel, splash mounted faucet, 1-1/2" crumb cup strainer, NSF

ITEM GEP5 - WORK TABLE, STAINLESS STEEL TOP (1 REQ'D)
Advance Tabco Model VSS-307
Work Table, 84"W x 30"D, 14 gauge 304 stainless steel top with countertop non drip edge, adjustable stainless steel undershelf, stainless steel legs & adjustable bullet feet, NSF

1 st Model TA-255 Casters, expanding adapter, for 1-5/8" dia. O.D. tube/table legs, 400 lb capacity per caster, set of (4) (2 with brakes)
2 ea Model SHD-2020 Drawer, 20"W x 20"D x 5" deep drawer pan insert, heavy duty, self-closing, stainless steel, NSF

ITEM GEP6 - ICE CUBER (1 REQ'D)
Scotsman Model C0830MA-32
Prodigy Plus® Ice Maker, cube style, air-cooled, self-contained condenser, production capacity up to 905 lb/24 hours at 70°/50° (718 lb AHRI certified at 90°/70°), stainless steel finish, medium cube size, 208-230v/60/1-ph, 10.2 amps, cULus, NSF, CE

1 ea 3 year parts & labor warranties
1 ea 5 year parts & labor warranties on Evaporator
1 ea 5 year parts on compressor & condenser
1 ea Model KVS Prodigy™ Vari-Smart™ Ice Level Control, program ice bin levels to match ice needs (field install only)
1 ea Model B842S Ice Bin, top-hinged front-opening door, 778 lb application capacity, for top-mounted ice maker, polyethylene liner, metallic finish exterior, includes 6" legs, NSF
1 ea 3 year parts & labor warranties
1 ea Model KBT29 Bin Top Kit, for 30" modular cubers on B842S, BH801 bin
1 st Model KLP8S Leg Kit, 6", stainless steel, for Bx22,Bx30, B842 & B948 bins, HD dispensers, CU1526, CU2026, CU3030 & AFE units

ITEM GEP6.1 - ICE BIN (1 REQ'D)
INCLUDED WITH ITEM #GEP6

ITEM GEP7 - WORK TABLE, STAINLESS STEEL TOP (1 REQ'D)
Advance Tabco Model KSS-308
Work Table, 96"W x 30"D, 14 gauge 304 stainless steel top with 5"H backsplash, 18 gauge stainless steel adjustable undershelf, stainless steel legs with stainless steel bullet feet, NSF

1 ea Model SHD-2020 Drawer, 20"W x 20"D x 5" deep drawer pan insert, heavy duty, self-closing, stainless steel, NSF

ITEM GER1 - AIR CURTAIN (1 REQ'D)
Berner Model SHD07-1048A
Sanitation Certified Series High Performance Air Curtain, 48" long, unheated, (1) 3/4 hp motor, for doors up to 7-feet high, specify exterior, indoor or exterior mounting, cULus, UL EPH Classified, MADE IN USA

1 ea Five year parts warranty (unheated units)
1 ea Model A 120v/60/1-ph, 7.5 amps
1 ea Model 9503SD020-P Automatic Door Switch, plunger type, activates air door when door opens, single phase only & max. amp draw of 20 amps, 120-240V
1 ea White powder coat exterior finish standard

ITEM GER2 - WALK-IN COOLER (1 REQ'D)
KPS Global LLC Model 11'-1" X 7'-1" X 7'-10 1/4"
OUTDOOR COOLER - WITH FLOOR

Dimensions: External: 11'-9" x 7'-9" x 8'-6 1/4", Internal: 11'-1" x 7'-1" x 7'-10 1/4"
Walls: 4" Insulframe Construction, ALZN White Stucco Embossed 26GA - Interior
ALZN Natural Stucco Embossed 26GA - Exterior
Ceilings: 4" Insulframe Construction, ALZN White Stucco Embossed 26GA - Interior
ALZN Natural Stucco Embossed 26GA - Exterior, Attachment Type: Lag Down
Floors: 4" Insulframe Construction, Alum Treadbrite Low Profile .080 - Interior
Attachment Type: Non-Lock Down, Single 1/2" OSB Plywood Underlay
(1) 2'-10" x 6'-6" Flushmount FRP Cooler Door - Left Out Swing
1 34" x 5" 12GA SS Threshold, 2 K-1346 Hinges, 1 K27C Deadbolt Brush Chrome
1 K1094 Flush Slotted Closer, 1 2" Dial Flush w/ 6' Lead, Thermometer on Exterior, Lead on Interior, 1 Standard Switch w/ Pilot Light Installed, 36" .058 DTA Kickplate Int/Ext
1 1827 Heated 230V Vent, 1 14 x 14 Non-Heated View Port Membrane roof cap and tapered foam

ITEM GER2.1 - WALK-IN COOLER EVAPORATOR COIL (1 REQ'D)
Bohn Refrigeration Model BEL0105AS6AMAB0405
BEL0105AS6AMAB0405 cooler evaporator coil. 120v 1ph

ITEM GER2.2 - WALK-IN COOLER CONDENSER (1 REQ'D)
Bohn Refrigeration Model BCH0015MBACZA0100
BCH0015MBACZA0100 cooler condenser. 208V 1ph. 1 1/2 HP

ITEM GER3 - KEG STORAGE RACK (1 REQ'D)
John Boos Model ALKR-2042
Keg Rack, 42"W x 20"D x 76"H, (3) shelves, accommodates (4) kegs, mid & bottom shelves are constructed of 1-3/4" square tubing running front-to-back with a load rating of 60 lb/ft², top shelf is constructed of 1-3/4" square tubing running left-to-right with a load rating of 15 lb/ft², 1-5/16" dia. post, aluminum construction

1 ea Model ALKRS-2042 Rear Keg Strap, for 42"W x 20"D keg rack, aluminum

ITEM GER4 - SECURITY UNIT (3 REQ'D)
Metro Model SEC33EK3
Super Erecta® Security Unit, mobile, Metroseal 3™ epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, 40-3/4"W x 21-1/2"D x 68-1/2"H, no intermediate shelves, (2) 5MP/5MPB casters, NSF

ITEM GER5 - WIRE SHELVING (16 REQ'D)
Metro Model 2136NK3
Quick Ship - Super Erecta® Shelf, wire, 36"W x 21"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF

4 ea Model 2130NK3 Quick Ship - Super Erecta® Shelf, wire, 30"W x 21"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
12 ea Model 2142NK3 Quick Ship - Super Erecta® Shelf, wire, 42"W x 21"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
32 ea Model 63UPK3 Quick Ship - Super Erecta® SiteSelect™ Post, 61-13/16"H, for use with stem casters, Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection

16 ea Model 5MP Quick Ship - Super Erecta® Stem Caster, swivel, 5" dia., 1-1/4" face, 300 lb. capacity, polyurethane flat wheel tread, includes bumper
16 ea Model 5MPB Quick Ship - Super Erecta® Stem Caster, swivel (with foot operated brake), 5" dia., 1-1/4" face, 300 lb. capacity, polyurethane flat wheel tread, includes bumper

ITEM GER6 - WALK-IN FREEZER (1 REQ'D)
KPS Global LLC Model 7'-3" X 7'-1" X 7'-10 1/4"
KPS ODWICFC
OUTDOOR FREEZER - WITH FLOOR - -10°F
Dimensions: External: 7'-11" x 7'-9" x 8'-6 1/4" Internal: 7'-3" x 7'-1" x 7'-10 1/4"
Walls: 4" Insulframe Construction, ALZN White Stucco Embossed 26GA - Interior
ALZN Natural Stucco Embossed 26GA - Exterior, ALZN White Stucco Embossed 26GA - Interior, ALZN White Stucco Embossed 22GA - Ext
Ceilings: 4" Insulframe Construction, ALZN White Stucco Embossed 26GA - Interior
ALZN Natural Stucco Embossed 26GA - Exterior, Attachment Type: Lag Down
Floors: 4" Insulframe Construction, Alum Treadbrite Low Profile .080 - Interior
Attachment Type: Non-Lock Down, Single 1/2" OSB Plywood Underl
(1) 2'-10" x 6'-6" Flushmount FRP Freezer Door - Left Out Swing
1 34" x 5" 12GA SS Threshold, 2 K-1346 Hinges, 1 K27C Deadbolt Brush Chrome
1 K1094 Flush Slotted Closer, 1 2" Dial Flush w/ 6' Lead, Thermometer on Exterior, Lead on Interior: 1 Standard Switch w/ Pilot Light Installed,36" .058 DTA Kickplate Int/Ext
1 1827 Heated 120V Vent, 1 14 x 14 Heated View Port

ITEM GER6.1 -WALK-IN FREEZER EVAPORATOR COIL (1 REQ'D)
Bohn Refrigeration Model BEL0080BS6EMAB0405
BEL0080BS6EMAB0405 freezer evaporator coil. 208V 1ph

ITEM GER6.2 -WALK-IN FREEZER CONDENSER (1 REQ'D)
Bohn Refrigeration Model BCH0025LBACZA0200
BCH0025LBACZA0200 freezer condenser. 208V 1ph, 2 1/2 HP

ITEM GER7 - WIRE SHELVING (5 REQ'D)
Metro Model 2130NK3
Quick Ship - Super Erecta® Shelf, wire, 30"W x 21"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF

15 ea Model 2142NK3 Quick Ship - Super Erecta® Shelf, wire, 42"W x 21"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
5 ea Model 2148NK3 Quick Ship - Super Erecta® Shelf, wire, 48"W x 21"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
20 ea Model 86UPK3 Quick Ship - Super Erecta® SiteSelect™ Post, 85-7/8"H, for use with stem casters, Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection
10 ea Model 5MPB Quick Ship - Super Erecta® Stem Caster, swivel (with foot operated brake), 5" dia., 1-1/4" face, 300 lb. capacity, polyurethane flat wheel tread, includes bumper
10 ea Model 5MP Quick Ship - Super Erecta® Stem Caster, swivel, 5" dia., 1-1/4" face, 300 lb. capacity, polyurethane flat wheel tread, includes bumper

ITEM GER8 - REACH-IN FREEZER (1 REQ'D)
Victory Refrigeration Model FS-1D-S1-EW-HC
UltraSpec™ Series Freezer, Reach-in, one-section, self-contained refrigeration, 24.08 cu. ft. capacity, (1) wide full height solid hinged door, (3) silver freeze (chrome-style) shelves, stainless exterior & interior, standard depth cabinet, TOUCH POINT™ electronic temperature control/indicator, LED lighting, expansion valve technology, Santoprene door gaskets with 2 year warranty, stainless steel breakers, R290 Hydrocarbon refrigerant, 3/4 HP, cULus, UL EPH Classified, UL-Sanitation, MADE IN USA

1 ea 3 years parts & labor warranty (excludes maintenance items)
1 ea Self-Contained refrigeration
1 ea Additional 4 year compressor warranty (part only), standard
1 ea 115v/60/1-ph, 9.1 amps, with cord & NEMA 5-15P
1 ea Door hinging: standard on right
1 ea 6" Casters, in lieu of standard 6" stainless steel legs, no charge when specified on order

ITEM GES1 - KIOSK ORDER STATION (2 REQ'D)
NIKEC - PROVIDED BY ARAMARK

ITEM GES2 - POS REGISTER (1 REQ'D)
NIKEC - PROVIDED BY ARAMARK

ITEM GEW1 - THREE (3) COMPARTMENT SINK (1 REQ'D)
Advance Tabco Model 94-83-60-24RL

Regaline Sink, 3-compartment, with left & right-hand drainboards, 28" front-to-back x 20"W sink compartments, 14" deep, with 11"H backsplash, stainless steel legs with adjustable left-to-right and front cross rails, 24" drainboards, 1" adjustable bullet feet, 14 gauge 304 stainless steel, overall 36" F/B x 115" L/R, NSF

- 1 ea 14" spout
- 1 ea Model K-111 T&S Heavy Duty Faucet, 8" OC, splash mounted with 14" swing spout, lead free
- 3 ea Model K-15 Lever Waste Drain, twist handle operated with built in overflow, fits 3-1/2" drain opening, 2" NPT & 1-1/2" IPS outlet connections
- 3 ea Model K-4 Support Bracket, for lever waste drain handle, (1) support required for each lever drain

ITEM GEW1.2 - FAUCET (1 REQ'D)
PROVIDED WITH ITEM #GEW1

ITEM GEW2 - DISHWASHER, UNDERCOUNTER (1 REQ'D)
Hobart Model LXER+BUILDUP
LXe Advansys Dishwasher, undercounter, 23-15/16"W x 26-13/16"D x 32-1/2"H, high temperature sanitizing, Energy Recovery, 30, 24, 13 Racks/Hour, Fresh Water Rinse, .62 gal/rack, Automated Delime Cycle, Clogged Wash Arm Alert, 3 selectable cycles - light, normal, heavy (Pot & Pan cycle on heavy cycle), Advanced Service Diagnostics, Detergent, Rinse Aid & Delimer Pump, ENERGY STAR®, Free factory startup for installations within a 100 mile radius of a Hobart service office; installation beyond 100 miles will be charged at the quoted rate by the local Hobart service office

- 1 ea Standard warranty - 1-Year parts, labor & travel time during normal working hours
- 1 ea Model LXER-ELE0KU 120/208-240v/60/1-ph (3 wire), 30.5 amps, standard
- 1 ea Model DWT-LXE Drain water tempering kit for LXe
- 1 ea Installation of DWT kit only (NET)
- 1 ea Model DISHRAK-PEG20 Peg rack
- 1 ea Model DISHRAK-COM20 Combination rack
- 1 ea Model WTRHAM-ARREST Water hammer arrestor kit, includes 3/4" brass pressure regulator valve
- 1 ea Model PRESREG-1/20BR 1/2" brass pressure regulator (is standard with built-in booster heater models)

ITEM GEW3 - OVERSHELF (1 REQ'D)
Advance Tabco Model PS-12-108

Shelf with Pot Rack, wall-mounted, 108"W x 12"D, 18/430 stainless steel shelf, 2" x 1/4" stainless steel pot rack, includes: (9) plated double pot hooks (units 96" & longer have (3) support brackets), NSF

ITEM GEW4 - WIRE SHELVING (5 REQ'D)
Metro Model 2148NK3
Quick Ship - Super Erecta® Shelf, wire, 48"W x 21"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF

- 4 ea Model 74UPK3 Quick Ship - Super Erecta® SiteSelect™ Post, 73-7/8"H, for use with stem casters, Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection
- 2 ea Model 5MP Quick Ship - Super Erecta® Stem Caster, swivel, 5" dia., 1-1/4" face, 300 lb. capacity, polyurethane flat wheel tread, includes bumper
- 2 ea Model 5MPB Quick Ship - Super Erecta® Stem Caster, swivel (with foot operated brake), 5" dia., 1-1/4" face, 300 lb. capacity, polyurethane flat wheel tread, includes bumper

ITEM GEW5 - STORAGE CABINET (1 REQ'D)
Piper Products/Servolift Eastern Model 7773-M
Storage Cabinet, mobile base frame, (4) shelves, hinged doors, 36" wide x 24" deep x 78" high, stainless steel construction

- 1 ea Model DRA Double reinforcing angles

ITEM GEW6 - BUSSING UTILITY TRANSPORT CART, METAL (2 REQ'D)
Lakeside Manufacturing Model 422
Utility Cart, 3-tier, open base, 500 lbs capacity, 18" x 27" shelf size, 11-1/2" shelf clearance, sound deadening panels, (1) push handle with bumpers, (2) bumpers on front legs, galvanized steel dolly frame, stainless steel construction, 4" swivel casters, Made in USA

- 2 ea Casters, 4" swivel, standard

ITEM GSB1 - BEVERAGE COUNTER (1 REQ'D)
NIKEC - BY GC / MILLWORK SUBCONTRACTOR

ITEM GSB2 - CUP / LID / STRAW DISPENSER (1 REQ'D)
NIKEC - PROVIDED BY ARAMARK

ITEM GSB3 - ICE / SODA DISPENSER (1 REQ'D)
NIKEC - PROVIDED BY SODA VENDOR

ITEM GSB3.1 - ICE MAKER, CUBE-STYLE (1 REQ'D)
Scotsman Model MC0330SA-1
Prodigy ELITE® Ice Maker, cube style, air-cooled, self-contained condenser, production capacity up to 400 lb/24 hours at 70°/50° (288 lb AHRI certified at 90°70°), small cube size, ICELINQ® mobile app, Bluetooth® connectivIty, preservation mode, external bin full indicator, AutoAlert™ indicating lights, WaterSense adjustable purge control, one-touch cleaning, harvest assist, front facing removable air filter, unit specific QR code, stainless steel finish, AgION™ antimicrobial protection, 115v/60/1-ph, 14.3 amps, cULus, NSF, engineered and assembled in USA

VERIFY / COORDINATE ICE MACHINE SELECTION WITH SODA DISPENSER TO BE USED FOR CORRECT FIT/OPERATION. SODA DISPENSER TO BE PROVIDED BY SODA VENDOR DIRECTLY TO ARAMARK AND IS NOT INCLUDED IN KEC SCOPE.

COORDINATE ICE MAKER MODEL AND ACCESSORIES WITH ICE/SODA DISPENSER.

1 ea 3 year parts & labor warranties
1 ea 5 year parts & labor warranties on Evaporator
1 ea 5 year parts on compressor & condenser
1 ea Model KBILC Basic Ice Level Control, thermistor technology, ideal for dispenser applications (field install only)
1 ea Model KSBU Prodigy SmartBoard ™, programable bin level control with KVS, uses additional operational data for fast diagnosis (field install only)

ITEM GSB4 - TEA BREWER (2 REQ'D)
NIKEC - BY VENDOR

ITEM GSB5 - COFFEE / TEA BREWER (1 REQ'D)
NIKEC - BY VENDOR

ITEM GSB6 - CUP / LID DISPENSER (1 REQ'D)
NIKEC - PROVIDED BY ARAMARK

ITEM GSB7 - CO2 CYLINDER TANK (1 REQ'D)
NIKEC - PROVIDED BY SODA VENDOR

ITEM GSB8 - BAG-IN-BOX SYSTEM (1 REQ'D)
NIKEC - PROVIDED BY SODA VENDOR

ITEM GSB9 - SODA CARBONATOR (1 REQ'D)
NIKEC - PROVIDED BY SODA VENDOR

ITEM GSB10 - REFRIGERATED MERCHANDISER (1 REQ'D)
True Mfg. - General Foodservice Model GDM-19T-HC~TSL01
Refrigerated Merchandiser, one-section, bottom mounted self-contained refrigeration, True standard look version 01, (4) shelves, (1) Low-E thermal glass hinged door, LED interior lights, powder coated steel exterior, white interior with stainless steel floor, R290 Hydrocarbon refrigerant, 1/3 HP, 115v/60/1-ph, 5.4 amps, NEMA 5-15P, cULus, UL EPH Classified, CE, Made in USA, ENERGY STAR®

1 ea NOTE: Commonly stocked model in black exterior, & white exterior; verify availability with factory
1 ea 7 year compressor warranty, 6 years parts warranty, 5 year labor warranty standard. Please visit www.truemfg.com for specifics standard
1 ea Self-contained refrigeration standard
1 ea Exterior: Black powder coated steel, standard
1 ea Interior: White aluminum, with white shelving, standard
1 ea Door hinged right standard
1 ea Sign, Plain Black in lieu of standard
1 st Castors, 2-1/2"

ITEM GSB11 - WATER FILTRATION SYSTEM (1 REQ'D)
Everpure Model HIGH FLOW CSR QUAD - 4FC
CSR Water Filtration System, High Flow CSR Quad-4FC, Quad, (1) EC210 Prefilter, (4) 4FC Fibredyne® carbon block cartridges, (1) SS-IMF scale inhibitor cartridge, reduces sediment, chlorine, taste & odor, cyst, turbidity, inhibits scale, 60,000 gallons capacity, 10 gpm flow rate, 0.2 micron, inlet water shut-off valve, outlet pressure gauge, flush valve, 3/4" inlet, (2) 3/4" outlet connections, for multiple equipment applications, NSF 42 & 53 (EV932944)

END OF SECTION 11 40 00

SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manually operated, single-roller shades.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
2. Section 079200 "Joint Sealants" for sealing the perimeters of installation accessories for light-blocking shades with a sealant.

1.2 ACTION SUBMITTALS

A. Sustainable Design Submittals:
1. Environmental Product Declaration: For each product.
2. Third-Party Certifications: For each product.
3. Third-Party Certified Life Cycle Assessment: For each product.
4. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20
5. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

C. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

1. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.

D. Samples for Initial Selection: For each type and color of shadeband material.

1. Include Samples of accessories involving color selection.

E. Samples for Verification: For each type of roller shade.

1. Shadeband Material: Not less than 10 inches (250 mm) square. Mark interior face of material if applicable.

F. Product Schedule: For roller shades. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.
B. Product Certificates: For each type of shadeband material.
C. Product Test Reports: For each type of shadeband material, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED, SINGLE-ROLLER SHADES

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. Draper, Inc.
2. Hunter Douglas Architectural.
3. MechoShade Systems, LLC.

B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains: Manufacturer's standard.

a. Loop Length: Full length of roller shade.
b. Limit Stops: Provide upper and lower ball stops.
c. Chain-Retainer Type: Clip, jamb mount.

2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.

a. Provide for shadebands that weigh more than 10 lb (4.5 kg) or for shades as recommended by manufacturer, whichever criterion is more stringent.

C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-End Location: Right side of interior face of shade.
2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
3. Shadeband-to-Roller Attachment: Removable spline fitting into integral channel in tube.

D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

E. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.

F. Shadebands:

1. Shadeband Material: Light-filtering fabric.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

a. Type: Enclosed in sealed pocket of shadeband material.
b. Color and Finish: As selected by Architect from manufacturer's full range.

G. Installation Accessories:

1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.

    a. Shape: L-shaped.
    b. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 4 inches (102 mm).

2. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.

    a. Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than 4 inches (102 mm).

3. Endcap Covers: To cover exposed endcaps.
4. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.3 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.

1. Source: Roller shade manufacturer.
2. Type: PVC-coated polyester.
3. Weave: Basketweave.
4. Thickness: 0.024 inches.
5. Weight: 13.5 oz./sq. yd..
6. Roll Width: 84 inches (2134 mm).
7. Orientation on Shadeband: Up the bolt.
8. Openness Factor: 3 percent.
9. Color: As selected by Architect from manufacturer's full range.

2.4 ROLLER SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch (6 mm) per side or 1/2-inch (13-mm) total, plus or minus 1/8 inch (3.1 mm). Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch (6 mm), plus or minus 1/8 inch (3.1 mm).

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:

1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
2. Skylight Shades: Provide battens and seams at uniform spacings along shadeband as required to ensure shadeband tracking and alignment through its full range of movement without distortion or sag of material.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

1. Opaque Shadebands: Located so shadeband is not closer than 2 inches (51 mm) to interior face of glass. Allow clearances for window operation hardware.

B. Roller Shade Locations: As indicated on Drawings.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.
B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION 122413

SECTION 123623.13 - PLASTIC-LAMINATE-CLAD COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad countertops.
2. Accessories.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Plastic-laminate-clad countertops.
2. Accessories.

B. Product Data Submittals: For each product.

C. Sustainable Design Submittals:

1. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
2. Product Data: For installation adhesives, indicating VOC content.
3. Laboratory Test Reports: For installation adhesives, indicating compliance with requirements for low-emitting materials.
4. Environmental Product Declaration: For each product.
5. Third-Party Certifications: For each product.
6. Third-Party Certified Life Cycle Assessment: For each product.
7. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20
8. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)

D. Shop Drawings: For plastic-laminate-clad countertops.

1. Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.
2. Show locations and sizes of cutouts and holes for items installed in plastic-laminate-clad countertops.

E. Samples: Plastic laminates in each type, color, pattern, and surface finish required in manufacturer's standard size.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.
B. Product Certificates: For the following:

1. Composite wood products.
2. High-pressure decorative laminate.
3. Chemical-resistant, high-pressure decorative laminate.
4. Adhesives.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
B. Installer Qualifications: Fabricator of products.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver countertops only after casework and supports on which they will be installed have been completed in installation areas.
B. Store countertops in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.
C. Keep surfaces of countertops covered with protective covering during handling and installation.

1.6 FIELD CONDITIONS

A. Environmental Limitations without Humidity Control: Do not deliver or install countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
B. Environmental Limitations with Humidity Control: Do not deliver or install countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 43 and 70 percent during the remainder of the construction period.
C. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

D. Established Dimensions: Where countertops are indicated to fit to other construction, establish dimensions for areas where countertops are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD COUNTERTOPS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of plastic-laminate-clad countertops indicated for construction, finishes, installation, and other requirements.
B. Grade: Premium.
C. Certified Wood: Certify wood products in accordance with the American Tree Farm System's "AFF Standard," the AF&PA's Sustainable Forestry Initiative, FSC STD-01-001 and FSC STD-40-004, or the standards of the Programme for Endorsement of Forest Certification.
D. High-Pressure Decorative Laminate: ISO 4586-3, Grade HGS.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. ABET Inc.
b. Formica Corporation.
c. Laminart LLC.
d. Nevamar Company, LLC.
e. Pionite; a Panolam Industries International, Inc. brand.
f. Wilsonart LLC.

E. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As indicated by manufacturer's designations.

F. Edge Treatment: 3.0-mm PVC edging.
G. Core Material: Particleboard or MDF.
H. Core Material at Sinks: MDF made with exterior glue or exterior-grade plywood.
I. Core Thickness: 3/4 inch (19 mm).

1. Build up countertop thickness to 1-1/2 inches (38 mm) at front, back, and ends with additional layers of core material laminated to top.

J. Backer Sheet: Provide plastic-laminate backer sheet, ISO 4586-3, grade to match exposed surface, on underside of countertop substrate.

K. Paper Backing: Provide paper backing on underside of countertop substrate.

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise indicated.

B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of countertop and quality grade specified unless otherwise indicated.

1. Recycled Content of MDF and Particleboard: Postconsumer recycled content plus one-half of preconsumer recycled content.
2. MDF: Medium-density fiberboard, ANSI A208.2, Grade 130.
3. Particleboard: ANSI A208.1, Grade M-2 or Grade M-2-Exterior Glue.
4. Softwood Plywood: DOC PS 1.

2.3 MISCELLANEOUS MATERIALS

A. Adhesive for Bonding Plastic Laminate: as selected by fabricator to comply with requirements.

1. Adhesive for Bonding Edges: Hot-melt adhesive.

B. Installation Adhesive:

1. Verify adhesives have a VOC content of 70 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify building concentration of formaldehyde does not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and acetaldehyde concentration does not exceed 9 mcg/cu. m.

2.4 FABRICATION

A. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 1 inch (25 mm) over base cabinets. Ease edges to radius indicated for the following:

B. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended, and check measurements of assemblies against field measurements before disassembling for shipment.

C. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately, and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of cutouts by saturating with varnish.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION

A. Grade: Install countertops to comply with same grade as item to be installed.
B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.

1. Provide cutouts for appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately, and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
2. Seal edges of cutouts by saturating with varnish.

C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.

1. Secure field joints in countertops with concealed clamping devices located within 6 inches (150 mm) of front and back edges and at intervals not exceeding 24 inches (600 mm). Tighten in accordance with manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

D. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
E. Countertop Installation: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Install countertops level and true in line. Use concealed shims as required to maintain not more than a 1/8-inch-in-96-inches (3-mm-in-2400-mm) variation from a straight, level plane.
2. Secure backsplashes to walls with adhesive.
3. Seal joints between countertop and backsplash, if any, and joints where countertop and backsplash abut walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects. Where not possible to repair, replace countertops. Adjust joinery for uniform appearance.
B. Clean countertops on exposed and semiexposed surfaces.
C. Protection: Provide Kraft paper or other suitable covering over countertop surfaces, taped to underside of countertop at a minimum of 48 inches (1220 mm) o.c. Remove protection at Substantial Completion.

END OF SECTION 123623.13

SECTION 123661.16 - SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid surface material countertops.
2. Solid surface material backsplashes.
3. Solid surface material end splashes.
4. Solid surface material window sills.
5. Solid surface material wall base.

1.2 ACTION SUBMITTALS

A. Product Data: For countertop materials.
B. Sustainable Design Submittals:

1. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
2. Product Data: For adhesives, indicating VOC content.
3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
4. Environmental Product Declaration: For each product.
5. Third-Party Certifications: For each product.
6. Third-Party Certified Life Cycle Assessment: For each product.
7. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20
8. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)

C. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

1. Show locations and details of joints.
2. Show direction of directional pattern, if any.

D. Samples for Verification: For the following products:

1. Countertop material, 4 inches square.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.
B. Installer Qualifications: Fabricator of countertops.
C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.

1. Build mockup of typical countertop as indicated on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.7 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

A. Solid Surface Material: Homogeneous-filled plastic resin complying with ISFA 2-01.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. DuPont; DuPont de Nemours, Inc.
b. Formica Corporation.
c. Hanex.
d. LG Hausys, Ltd.
e. Meganite Inc.
f. Wilsonart LLC.

2. Type: Provide Standard type or Veneer type made from material complying with requirements for Standard type, as indicated unless Special Purpose type is indicated.
3. Colors and Patterns: As indicated by manufacturer's designations.

B. Particleboard: ANSI A208.1, Grade M-2 and Grade M-2-Exterior Glue.
C. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 FABRICATION

A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Premium.

B. Configuration:

1. Front: Straight, slightly eased at top.
2. Backsplash: Straight, slightly eased at corner.
3. End Splash: Matching backsplash.

C. Countertops:

1. 1/2-inch- (12.7-mm-) thick, solid surface material with front edge built up with same material.

D. Backsplashes: 1/2-inch- (12.7-mm-) thick, solid surface material.
E. Window Sills: 1/2-inch- (12.7-mm-) thick, solid surface material.
F. Wall Cladding: 1/4-inch- (6.3-mm-) thick, solid surface material.
G. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

1. Fabricate with loose backsplashes for field assembly.

H. Joints:
1. Fabricate straight countertops eight feet of less in length without joints. Where size and configuration of countertops exceed dimensions of solid surface slab, fabricate countertops in sections for joining in field, with joints in locations indicated on approved Shop Drawings.

a. Joint Locations: Not within 18 inches (450 mm) of a sink or cooktop and not where a countertop section less than 36 inches (900 mm) long would result, unless unavoidable.

b. Splined Joints: Accurately cut kerfs in edges at joints for insertion of metal splines to maintain alignment of surfaces at joints. Make width of cuts slightly more than thickness of splines to provide snug fit.

I. Cutouts and Holes:

1. Undercounter Plumbing Fixtures: Make cutouts for fixtures using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

   a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch (5 mm) into fixture opening.

2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by solid surface material manufacturer.

1. Verify adhesives have a VOC content of 70 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify building concentration of formaldehyde does not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and acetaldehyde concentration does not exceed 9 mcg/cu. m.

B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet (3 mm in 2.4 m), 1/4 inch (6 mm) maximum. Do not exceed 1/64-inch (0.4-mm) difference between planes of adjacent units.

B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

D. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

E. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

    1. Install metal splines in kerfs in countertop edges at joints. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
    2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.

F. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.

G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

    1. Seal edges of cutouts in particleboard subtops by saturating with varnish.

H. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 123661.16

SECTION 123661.19 - QUARTZ AGGLOMERATE COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Quartz agglomerate countertops.
2. Quartz agglomerate backsplashes.
3. Quartz agglomerate end splashes.

1.2 ACTION SUBMITTALS

A. Product Data: For countertop materials.
B. Sustainable Design Submittals:
1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
3. Environmental Product Declaration.
4. Third-Party Certifications: For each product.
5. Third-Party Certified Life Cycle Assessment: For each product.
6. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20
7. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)

C. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

1. Show locations and details of joints.
2. Show direction of directional pattern, if any.

D. Samples for Verification: For the following products:

1. Countertop material, 6 inches (150 mm) square.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For quartz agglomerate countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.
B. Installer Qualifications: Fabricator of countertops.
C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.

1. Build mockup of typical countertop as indicated on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.7 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 QUARTZ AGGLOMERATE COUNTERTOP MATERIALS

A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of polymers, resins, and pigment and complying with ISFA 3-01.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Cambria.
b. Cosentino North America; C&C North America, Inc.
c. DuPont; DuPont de Nemours, Inc.
d. LG Hausys, Ltd.
e. Terrazzo & Marble Supply Companies.
f. Wilsonart LLC.

2. Colors and Patterns: As indicated by manufacturer's designations.

B. Particleboard: ANSI A208.1, Grade M-2 or Grade M-2-Exterior Glue.
C. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 FABRICATION

A. Fabricate countertops according to quartz agglomerate manufacturer's written instructions and the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Premium.

B. Countertops: 3/4-inch- (19-mm-) thick, quartz agglomerate with front edge built up with same material.
C. Backsplashes: 3/4-inch- (19-mm-) thick, quartz agglomerate.
D. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

1. Fabricate with loose backsplashes for field assembly.

E. Joints:
1. Fabricate straight countertops eight feet of less in length without joints. Where size and configuration of countertops exceed dimensions of solid surface slab, fabricate countertops in sections for joining in field, with joints in locations indicated on approved Shop Drawings.

a. Joint Locations: Not within 18 inches (450 mm) of a sink or cooktop and not where a countertop section less than 36 inches (900 mm) long would result, unless unavoidable.
b. Joint Type, Bonded: 1/32 inch (0.8 mm) or less in width.
c. Joint Type, Grouted: 1/16 inch (1.5 mm) in width.
d. Joint Type, Sealant Filled: 1/16 inch (1.5 mm) in width.
e. Splined Joints: Accurately cut kerfs in edges at joints for insertion of metal splines to maintain alignment of surfaces at joints. Make width of cuts slightly more than thickness of splines to provide snug fit.

F. Cutouts and Holes:

1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch (5 mm) into fixture opening.

2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by quartz agglomerate manufacturer.

1. Verify adhesives have a VOC content of 70 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify building concentration of formaldehyde does not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and acetaldehyde concentration does not exceed 9 mcg/cu. m.

B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive quartz agglomerate countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet (3 mm in 2.4 m), 1/4 inch (6 mm) maximum. Do not exceed 1/64-inch (0.4-mm) difference between planes of adjacent units.
B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

D. Secure countertops to subtops with adhesive according to quartz agglomerate manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

E. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

1. Install metal splines in kerfs in countertop edges at joints. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.

F. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.

G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

1. Seal edges of cutouts in particleboard subtops by saturating with varnish.

H. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 123661.19

SECTION 142400 - HYDRAULIC ELEVATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Hydraulic elevators.
B. Related Requirements:
   1. Section 015000 "Temporary Facilities and Controls" for temporary use of elevators for construction purposes.
   2. Section 055000 "Metal Fabrications" for the following:

      a. Attachment plates and angle brackets for supporting guide-rail brackets.
      b. Hoist beams.
      c. Structural-steel shapes for subsills.
      d. Pit ladders.

1.2 DEFINITIONS

A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.
B. Service Elevator: A passenger elevator that is also used to carry freight.

1.3 ACTION SUBMITTALS

A. Product Data: Hydraulic elevators.
B. Product Data Submittals: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for car enclosures; hoistway entrances; and operation, control, and signal systems.
C. Shop Drawings:

   1. Include plans, elevations, sections, and large-scale details indicating service at each landing; equipment layout; coordination with building structure; relationships with other construction; and locations of equipment.
   2. Include large-scale layout of car-control station and standby-power operation control panel.
   3. Indicate maximum dynamic and static loads imposed on building structure at points of support as well as maximum and average power demands.

D. Sustainable Design Submittals:

   1. Environmental Product Declaration: For each product.

2. Third-Party Certifications: For each product.
3. Third-Party Certified Life Cycle Assessment: For each product.
4. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20
5. Sustainable Materials Attributes – Sustainable Materials Index (recycled material)

E. Samples for Initial Selection: For finishes involving color selection.
F. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes, 3-inch- (75-mm-) square Samples of sheet materials and 4-inch (100-mm) lengths of running trim members.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.
B. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Manufacturer Certificates: Signed by elevator manufacturer, certifying that hoistway, pit, and equipment layout and dimensions, as indicated on Drawings, and electrical service, as indicated and specified, are adequate for elevator system being provided.
D. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.

1. Submit manufacturer's/installer's standard operation and maintenance manual, in accordance with ASME A17.1/CSA B44 including diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.

B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
C. Provide any special tools, equipment or software that are required for elevator maintenance.

D. Any equipment that is provided for installation which would require any specialized tools, devices, manuals, source codes, access codes, objects, passwords and/or software to input parameters, make adjustments, troubleshoot, perform diagnostics, perform testing functions or required for any other type of maintenance or repair function shall be included with the close out documentation. A letter stating that all listed above is provided is also required in addition to the equipment etc.

E. Continuing Maintenance Proposal:

1. Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard two-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.
2. Submit a continuing maintenance proposal from Installer to Owner with terms, conditions, and obligations as set forth in, and in same form as, "Draft of Elevator Maintenance Agreement" at end of this Section, starting on date initial maintenance service is concluded.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Elevator manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials, components and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.8 COORDINATION

A. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.

B. Coordinate locations and dimensions of other work specified in other Sections that relates to hydraulic elevators, including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and equipment.

1.9 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual

deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

2. Warranty Period: 1 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 HYDRAULIC ELEVATORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Otis Worldwide Corporation; Otis Hydrofit (Machineroomless hydraulic elevator) or a comparable product by one of the following:
   1. Schindler Elevators
   2. TK (Thyssen Krupp) Elevators

2.2 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.
B. Accessibility Standard: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines and ICC A117.1.
C. Seismic Performance: Elevator system withstands the effects of earthquake motions determined according to ASCE/SEI 7 and complies with elevator seismic requirements in ASME A17.1/CSA B44.

   1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified."
   2. Project Seismic Design Category: C.
   3. Elevator Component Importance Factor: 1.0.
   4. Design earthquake spectral response acceleration short period (Sds) for Project is 0.325
   5. Provide earthquake equipment required by ASME A17.1/CSA B44.

2.3 ELEVATORS

A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturers' standard components are used, as included in standard elevator systems and as required for complete system.
B. Elevator Description:
   1. Type:
      a. Machineroomless.

   2. Rated Load: 3500 lb (1589 kg).
   3. Rated Speed: 125 fpm (0.64 m/s).
   4. Operation System: Single automatic operation.

5. Auxiliary Operations:
   a. Battery-powered lowering.
   b. Nuisance call cancel.

6. Security Features: Card-reader operation.
7. Car Enclosures:

   a. Inside Width: Not less than 70 inches (1778 mm) from side wall to side wall.
   b. Inside Depth: Not less than 64-1/2 inches (1638 mm) from back wall to front wall (return panels).
   c. Inside Height: Not less than 93 inches (2362 mm) to underside of ceiling.
   d. Front Walls (Return Panels): Satin stainless steel, ASTM A480/A480M, No. 4 finish with integral car door frames.
   e. Car Fixtures: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
   f. Side and Rear Wall Panels: Plastic laminate.
   g. Reveals: Black.
   h. Door Faces (Interior): Satin stainless steel, ASTM A480/A480M, No. 4 finish.
   i. Door Sills: Aluminum.
   j. Ceiling: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
   k. Handrails: 1-1/2 inches (38 mm) round satin stainless steel, at sides and rear of car.
   l. Floor prepared to receive resilient flooring.

8. Hoistway Entrances:

   a. Width: 42 inches (1067 mm).
   b. Height: 84 inches (2134 mm).
   c. Type: Single-speed side sliding.
   d. Frames: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
   e. Doors and Transoms: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
   f. Sills: Aluminum.

9. Hall Fixtures: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
10. Additional Requirements:

   a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, ASTM A480/A480M, No. 4 finish.
   b. Provide hooks for protective pads in all cars and one complete set(s) of full-height protective pads.

2.4 SYSTEMS AND COMPONENTS

A. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations.

1. Pump is submersible type with submersible squirrel-cage induction motor, and suspended inside oil tank from vibration isolation mounts or is tank-top-mounted type with fan-cooled, squirrel-cage induction motor, and is mounted on oil tank with vibration isolation

mounts and enclosed in prime-painted steel enclosure lined with 1-inch- (25-mm-) thick, glass-fiber insulation board.

B. Hydraulic Silencers: System has hydraulic silencer containing pulsation-absorbing material in blowout-proof housing at pump unit.
C. Piping: Size, type, and weight of piping as recommended by elevator manufacturer, with flexible connectors to minimize sound and vibration transmissions from power unit.
D. Hydraulic Fluid:
   1. Hydraulic Fluid, Nontoxic and Biodegradable: Nontoxic, biodegradable fluid, made from vegetable oil with antioxidant, anticorrosive, antifoaming, and metal-passivating additives, that is approved by elevator manufacturer for use with elevator equipment.

E. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.
F. Car Frame and Platform: Welded steel units.
G. Guides: Roller guides Polymer-coated, nonlubricated sliding guides or sliding guides with guide-rail lubricators. Provide guides at top and bottom of car frame.

2.5 OPERATION SYSTEMS

A. Provide manufacturer's standard microprocessor operation system as required to provide type of operation indicated.
B. Auxiliary Operations:

   1. Single-Car Battery-Powered Lowering:

      a. If power fails and car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is between floors, it is lowered to a preselected floor, opens its doors, and shuts down. If car is below the preselected floor, it is lowered to the next lower floor, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.
      b. When power fails, car is lowered to the lowest floor, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.

   2. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors start closing.
   3. Automatic Operation of Lights and Fan: When elevator is stopped and unoccupied with doors closed, lighting, ventilation fan, and cab displays are de-energized after 5 minutes and are re-energized before car doors open.
   4. Flood Protection: Provide float switch to send elevator from first floor to second floor during flooding.

C. Security Features: Security features do not affect emergency firefighters' service.

1. Card-Reader Operation: System uses card readers at hall push-button stations to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in machine area for interconnecting card readers, other security access system equipment, and elevator controllers.
2. Security Camera: Security camera mounted in ceiling of elevator. Provide required conductors in traveling cable and 12x12x12 box in hoistway to transition from elevator wiring to building wiring.

2.6 DOOR-REOPENING DEVICES

A. Infrared Array: Provide door-reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams causes doors to stop and reopen.

2.7 CAR ENCLOSURES

A. Provide enameled- or powder-coated-steel car enclosures to receive removable wall panels, with removable car roof, access doors, power door operators, and ventilation.

1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.

B. Materials and Finishes: Manufacturer's standards, but not less than the following:

1. Subfloor:

a. Exterior, underlayment-grade plywood, not less than 5/8-inch (15.9-mm) nominal thickness.

2. Floor Finish:

a. Specified in Division 9 and finish schedule

3. Stainless Steel Wall Panels: Flush, formed-metal construction; fabricated from stainless steel sheet.
4. Plastic-Laminate Wall Panels: Plastic laminate adhesively applied to 1/2-inch (13-mm) fire-retardant-treated particleboard with manufacturer's standard protective edge trim. Panels have a flame-spread index of 25 or less, when tested according to ASTM E84. Plastic-laminate color, texture, and pattern as selected by Architect from elevator manufacturer's full range.
5. Fabricate car with recesses and cutouts for signal equipment.
6. Fabricate car door frame integrally with front wall of car.
7. Stainless Steel Doors: Flush, hollow-metal construction; fabricated from stainless steel sheet.
8. Sight Guards: Provide sight guards on car doors.
9. Sills: Extruded or machined metal, with grooved surface, 1/4 inch (6.4 mm) thick.
10. Ceiling: Metal flush panels, with LED lighting

11. Light Fixture Efficiency: Not less than 35 lumens/W.
12. Ventilation Fan Efficiency: Not less than 3.0 cfm/W (1.4 L/s per W).

2.8 HOISTWAY ENTRANCES

A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile accommodate hoistway wall construction.

1. Where gypsum board wall construction is indicated, frames are self-supporting with reinforced head sections.

B. Fire-Rated Hoistway Entrance Assemblies: Door-and-frame assemblies comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible according to NFPA 252 or UL 10B.

1. Fire-Protection Rating: 1 hour with 30-minute temperature rise of 450 deg F (250 deg C).

C. Materials and Fabrication: Manufacturer's standards, but not less than the following:

1. Enameled- or Powder-Coated-Steel Frames: Formed from cold- or hot-rolled steel sheet. Provide with factory-applied enamel or powder-coat finish; colors as selected by Architect from manufacturer's full range.
2. Primed or Powder-Coated-Steel Frames: Formed from cold- or hot-rolled steel sheet. Provide with factory-applied, rust-resistant primer or powder coating for field painting.
3. Stainless Steel Frames: Formed from stainless steel sheet.
4. Stainless Steel Doors and Transoms: Flush, hollow-metal construction; fabricated from stainless steel sheet.
5. Sight Guards: Provide sight guards on doors matching door edges.
6. Sills: Extruded or machined metal, with grooved surface, 1/4 inch (6.4 mm) thick.
7. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M.

2.9 SIGNAL EQUIPMENT

A. Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Provide buttons and lighted elements illuminated with LEDs.

B. Car-Control Stations: Provide manufacturer's standard recessed car-control stations. Mount in return panel adjacent to car door unless otherwise indicated.

1. Mark buttons and switches for required use or function. Use both tactile symbols and Braille.
2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.

C. Swing-Return Car-Control Stations: Provide car-control stations mounted on rear of hinged return panel adjacent to car door and with buttons, switches, controls, and indicator lights projecting through return panel but substantially flush with face of return panel.

1. Mark buttons and switches for function. Use both tactile symbols and Braille.
2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.

D. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.
1. Must comply with IBC 3001.2
2. Must comply with ASME A17.1 2.27.1

E. Hall Push-Button Stations: Provide one hall push-button station at each landing.

1. Provide manufacturer's standard wall-mounted units or jamb-mounted units.
2. Equip units with buttons for calling elevator and for indicating applicable direction of travel.

F. Hall Lanterns: Units with illuminated arrows; however, provide single arrow at terminal landings. Provide one of the following:

1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
2. Units with flat faceplate for mounting with body of unit recessed in wall and with illuminated elements projecting from faceplate for ease of angular viewing.
3. Units mounted in both jambs of entrance frame.

G. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.

1. At manufacturer's option, audible signals may be placed on cars.

H. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

2.10 FINISH MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, commercial steel, Type B, exposed, matte finish.
B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, commercial steel, Type B, pickled.
C. Stainless Steel Sheet: ASTM A240/A240M, Type 304.

D. Stainless Steel Bars: ASTM A276/A276M, Type 304.
E. Stainless Steel Tubing: ASTM A554, Grade MT 304.
F. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063.
G. Plastic Laminate: High-pressure type complying with ISO 4586-3, Type HGS for flat applications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.
B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF HYDRAULIC ELEVATORS

A. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor and braced at intervals as needed to maintain alignment. Anchor cylinder guides at spacing needed to maintain alignment and avoid overstressing guides.
B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS workmanship and welding operator qualification standards.
C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.
D. Lubricate operating parts of systems as recommended by manufacturers.
E. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
F. Leveling Tolerance: 1/4 inch (6 mm), up or down, regardless of load and travel direction.
G. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.

H. Locate hall signal equipment for elevators as follows unless otherwise indicated:
1. Place hall lanterns either above or beside each hoistway entrance.
2. Mount hall lanterns at a minimum of 72 inches (1829 mm) above finished floor.

3.3 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.
B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

3.4 PROTECTION

A. Temporary Use: Comply with the following requirements for elevator used for construction purposes:

1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
2. Provide strippable protective film on entrance and car doors and frames.
3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
5. Do not load elevators beyond their rated weight capacity.
6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevator(s).
B. Check operation of elevator with Owner's personnel present before date of Substantial Completion and again not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

3.6 MAINTENANCE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service includes 12 months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation. Parts and supplies are manufacturer's authorized replacement parts and supplies.

1. Perform maintenance during normal working hours.
2. Perform emergency callback service during normal working hours with response time of two hours or less.
3. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of two hours or less.

END OF SECTION 142400

SECTION 210500 – COMMON WORK RESULTS FOR FIRE PROTECTION

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. Fire-suppression system submittal requirements.
2. Sleeves and sleeve seal systems.
3. Escutcheons.
4. Hangers and supports.
5. Identification.

B. Related Requirements:
1. Division 07 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.
2. Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment" for vibration isolation devices and seismic restraints.
3. Section 211200 "Fire-Suppression Standpipes" for standpipes.
4. Section 211313 "Wet-Pipe Sprinkler Systems" for wet-pipe sprinkler piping.
5. Section 211316 "Dry-Pipe Sprinkler Systems" for dry-pipe sprinkler piping.

C. Contractor shall furnish in-building riser(s) to civil site contractor for installation as part of the underground fire-suppression water-service piping.
1. Contractor shall coordinate with the civil site fire water-service provided under another Division.
2. Contractor shall perform all work within the building.

1.3 DEFINITIONS

A. "Contractor" means an individual or entity licensed to engage in the planning, sale, installation, repair, alteration, addition, maintenance, or inspection of fire suppression systems.

B. "Architect" means principal design professional for the project. In certain types of projects, the principal design professional may be an engineer rather than an architect. For such projects, within the bounds of these specifications, where the term "architect" is used, it may refer instead to the engineer.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For fire-suppression standpipe and sprinkler systems.
1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For fire-suppression standpipe and sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data. Submittal shall be completed by a fire sprinkler contractor licensed in the State with a qualifying party holding a NICET Level IV Technician Certification in "Fire Protection Engineering Technology Automatic Sprinkler System Layout."

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For licensed fire sprinkler contractor or professional engineer.

B. Fire-Suppression System Drawings: Working plans, prepared according to NFPA 13 and 14, must be prepared for every fire sprinkler system.
1. Hydraulic Calculations: Fire suppression system shop drawings and hydraulic calculations must contain sufficient information to show compliance with the drawings and National Fire Protection Association standards required in the Fire Sprinkler System Specification Sheet (FSSSS).
2. Fire sprinkler shop drawings must be prepared by a licensed fire suppression contractor for every fire suppression system and in accordance with South Carolina Code of Laws - Fire Protection Sprinkler Systems Act (Title 40, Chapter 10).
    a. Shop drawings must bear the authorized signature and license number of the fire sprinkler contractor licensed in this State who prepared the drawings.
3. The shop drawings shall accurately reflect actual conditions affecting the required layout of the fire sprinkler system.
    a. Shop drawings shall show light fixtures, large ducts, mechanical equipment, structural elements, architectural elements and all other items which may affect the layout of sprinkler heads and piping. Plans showing sprinkler work shall be not less than 1/8 inch per foot.
    b. Shop drawings shall show locations of pipe supports, seismic braces and end-of-line pipe restraints in plan view. Shop drawings shall also detail pipe supports, seismic braces and end-of-line restraints.
    c. The shop drawings shall indicate all areas to be sprinkled and type of hazard, locations and sizes of water supply pipe, major drains and tests, alarm check valve and water motor gong, risers and other main piping and valves, and the location of fire department connections. Complete riser diagrams shall also be submitted. The drawings shall locate by dimension all fire protection piping and sprinkler heads.
    d. Shop drawings shall be provided in sufficient detail to show compliance with the Standards referenced on the Fire Sprinkler System Specification Sheet (FSSSS) to the degree required by the regulations of the State Fire Marshal.
4. The fire sprinkler contractor shall certify the accuracy of his shop drawings prior to submitting them for review and approval.

5. The fire sprinkler shop drawings shall be reviewed and approved by the Architect's Engineer of Record who prepared the Fire Sprinkler System Specification Sheet.
6. After determination of compliance with the Fire Sprinkler System Specification Sheet, the Engineer of Record will issue a Certificate of Compliance.
7. The fire sprinkler contractor shall submit the shop drawings, Fire Sprinkler System Specification Sheet and Certificate of Compliance to the State Fire Marshal's Office or to his designee for further review and approval.
8. Upon approval by the State Fire Marshal's Office, the Architect's Engineer of Record will submit a copy of the State Fire Marshal's approval letter to the Contractor, Architect, and Authority Having Jurisdiction (AHJ).
9. Unless authorized in writing by AHJ, neither the Contractor nor subcontractor at any tier shall submit the fire sprinkler shop drawings directly to the State Fire Marshal's Office or other authorities having jurisdiction for approval.

C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13 and 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-suppression systems and specialties to include in emergency, operation, and maintenance manuals.

B. At Final Completion, six (6) copies of the approved manual with as-built drawings and a copy of NFPA-25 shall be delivered to the Owner.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:
1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing licensed engineering services needed to assume design responsibility. Base calculations on results of fire-hydrant flow test.

    a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified licensed contractor.
    b. The installer shall hold all licenses and obtain all permits necessary to perform work of this type.
    c. The installer shall be regularly engaged in the fabrication, installation, testing, and servicing of automatic sprinkler systems.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. NFPA Standards:

1. Fire-suppression piping, equipment, specialties, accessories, installation, and testing shall comply with NFPA 13 and 14.

1.8 PERFORMANCE REQUIREMENTS

A. Structural Performance: Fire-suppression piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to NFPA and ASCE/SEI 7.
   1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
   2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
   3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

B. NFPA Compliance: Comply with NFPA 13, NFPA 14.

1.9 FIELD CONDITIONS

A. Interruption of Existing Fire-Suppression Service: Do not interrupt fire-suppression service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary fire-suppression service according to requirements indicated:
   1. Notify Owner no fewer than ten (10) days in advance of proposed interruption of sprinkler service.
   2. Do not proceed with interruption of fire-suppression service without Owner's written permission.

1.10 WARRANTY PERIOD

A. The Contractor shall provide a one (1) year warranty for all materials and workmanship beginning with the date of Substantial Completion. The Contractor shall be responsible during the design, installation, testing, and warranty periods for any damage caused by him or his subcontractors or by defects in his or his subcontractors' work, materials, or equipment.

PART 2 - PRODUCTS

2.1 SLEEVES AND SLEEVE SEAL SYSTEMS

A. Sleeves
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Advance Products & Systems, Inc
      b. CALPICO, Inc
      c. GPT; an EnPro Industries company

2. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.
3. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, anticorrosion coated or galvanized, with plain ends and integral welded waterstop collar.
4. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Sleeve-Seal Systems
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Advance Products & Systems, Inc
   b. CALPICO, Inc
   c. GPT; an EnPro Industries company
   d. Metraflex Company (The)
   e. Proco Products, Inc
2. Description:
   a. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
   b. Designed to form a hydrostatic seal of 20 psig minimum.
   c. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   d. Pressure Plates: Carbon steel.
   e. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B 633 of length required to secure pressure plates to sealing elements.

C. Sleeve-Seal Fittings
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Advance Products & Systems, Inc
   b. CALPICO, Inc
   c. GPT; an EnPro Industries company
   d. Metraflex Company (The)
   e. Proco Products, Inc
2. Description:
   a. Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.
   b. Plastic or rubber waterstop collar with center opening to match piping OD.

D. Grout
1. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
2. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
3. Design Mix: 5000-psi, 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

2.2 ESCUTCHEONS

A. Manufacturers

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. BrassCraft Manufacturing Co.; a Masco company
   b. Dearborn Brass
   c. Keeney Manufacturing Company (The)
   d. Mid-America Fittings, Inc.
   e. ProFlo; a Ferguson Enterprises, Inc. brand

B. Escutcheons
1. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
2. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.
3. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
4. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel or brass with polished, chrome-plated finish and spring-clip fasteners.
5. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
6. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

C. Floor Plates
1. Split Floor Plates: Steel with concealed hinge.

2.3 IDENTIFICATION

A. Equipment Labels
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brady Corporation
   b. Brimar Industries, Inc.
   c. Carlton Industries, LP
   d. Craftmark Pipe Markers
   e. Kolbi Pipe Marker Co.
   f. LEM Products Inc.
   g. Seton Identification Products
2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
3. Letter Color: White.
4. Background Color: Black.
5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
6. Minimum Label Size: Length and width vary for required label content, but not less than 4 by 2-1/2 inch.
7. Minimum Letter Size: 3/4 inch.
8. Fasteners: Stainless-steel rivets or self-tapping screws, or double face adhesive.
9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
10. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

B. Warning Sings and Labels

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brady Corporation
   b. Brimar Industries, Inc.
   c. Carlton Industries, LP
   d. Craftmark Pipe Markers
   e. Kolbi Pipe Marker Co.
   f. LEM Products Inc.
   g. Seton Identification Products
2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.
3. Letter Color: White.
4. Background Color: Red.
5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
7. 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.
8. Fasteners: Stainless-steel rivets or self-tapping screws.
9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
10. Label Content: Include caution and warning information, plus emergency notification instructions.

2.4 HANGERS AND SUPPORTS

A. It shall be the responsibility of the Contractor to provide an adequate pipe hanger and support system for all pipe systems in accordance with recognized engineering practices, using standard, commercially accepted pipe hangers and suspension equipment. Comply with UL 203.

B. Metal Pipe Hangers and Supports
   1. Carbon-Steel Pipe Hangers and Supports:
      a. Description: Factory-fabricated components, NFPA approved, UL listed, or FM approved for fire-suppression piping support.
      b. Galvanized Metallic Coatings: Pregalvanized or hot-dip galvanized.
      c. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

C. Fastener Systems
   1. Powder-Actuated Fasteners: NFPA-approved, UL-listed, or FM-approved threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Hilti, Inc.
         2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
         3) MKT Fastening, LLC
         4) Simpson Strong-Tie Co., Inc.

2. Mechanical-Expansion Anchors: NFPA-approved, UL-listed, or FM-approved, insert-wedge-type anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        1) B-line, an Eaton business
        2) Hilti, Inc.
        3) ITW Ramset/Red Head; Illinois Tool Works, Inc.
        4) MKT Fastening, LLC
    b. Indoor Applications: Zinc-coated or stainless steel.
    c. Outdoor Applications: Stainless steel.
3. Per IBC Section 1905 and ACI 318 Appendix D, all concrete anchors within the scope of ACI 318 require approved anchors for crack concrete. Attachment devices shall have certified load test data from an independent test laboratory and shall be capable of carrying a minimum of five times the design load. The concrete anchors for the following supported items need to meet the crack concrete requirements:
    a. Any suspended pipe, larger than 2", regardless of material.
    b. All components with an Ip 1.5.
    c. All components required to function after a seismic event.
    d. Anywhere required by ASCE 7.

D. Pipe Stands
1. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
2. Compact Pipe Stand:
    a. Description: NFPA-approved, single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
    b. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
    c. Hardware: Galvanized steel or polycarbonate.
    d. Accessories: Protection pads.
3. High-Profile, Single-Base, Single-Pipe Stand:
    a. Description: NFPA-approved, single base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
    b. Base: Single vulcanized rubber or molded polypropylene.
    c. Vertical Members: Two galvanized-steel, continuous-thread, 1/2-inch rods.
    d. Horizontal Member: One adjustable-height, galvanized-steel, pipe-support slotted channel or plate.
    e. Pipe Supports: Roller, clevis hanger or swivel hanger.
    f. Hardware: Galvanized steel.
    g. Accessories: Protection pads, 1/2-inch, continuous-thread, galvanized-steel rod.
    h. Height: 36 inches above roof, unless otherwise noted.
4. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

E. Equipment Supports
1. Description: NFPA-approved, UL-listed, or FM-approved, welded, shop- or field-fabricated equipment support, made from structural-carbon-steel shapes.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. Fasten sleeves securely in floors and walls so that they will not become displaced when concrete is poured or when other construction is built around them. Take precautions to prevent concrete, plaster or other materials from being forced into space between pipe and sleeve during construction

C. 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.

D. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
   2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

E. 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 minimum 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

F. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Use grout to seal the space around outside of sleeve-seal fittings.

3.5 ESCUTCHEON INSTALLATION

A. Install escutcheons for exposed piping penetrations of finished walls, ceilings, and floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
   1. Escutcheons for New Piping and Relocated Existing Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
      b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece or split-plate with concealed hinge with polished, chrome-plated finish.
      c. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-plate with concealed hinge with polished, chrome-plated finish.
      d. Bare Piping in Unfinished Service Spaces: One-piece or split-plate with concealed hinge with polished, chrome-plated finish.
      e. Bare Piping in Equipment Rooms: One-piece or split-plate with concealed hinge with polished, chrome-plated finish.
   2. Escutcheons for Existing Piping to Remain:
      a. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate with concealed hinge with polished, chrome-plated finish.
      b. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate with concealed hinge with polished, chrome-plated finish.
      c. Bare Piping in Unfinished Service Spaces: Split-plate with concealed hinge with polished, chrome-plated finish.
      d. Bare Piping in Equipment Rooms: Split-plate with concealed hinge with polished, chrome-plated finish.

C. Install floor plates for exposed piping penetrations of floors in finished areas with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
   1. New Piping and Relocated Existing Piping: One-piece, floor plate.
   2. Existing Piping: Split floor plate.

3.6 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with installation requirements of approvals and listings. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Fastener System Installation:
   1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Install in accordance with approvals and listings.
   2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. Install in accordance with approvals and listings.

C. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

D. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

E. Install hangers and supports to allow controlled seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

F. Install lateral bracing with pipe hangers and supports to prevent swaying.

G. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.

H. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

I. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

3.7 EQUIPMENT LABEL INSTALLATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. Install or permanently fasten labels on each major item of mechanical equipment.

E. Locate equipment labels where accessible and visible.

3.8 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.

3.9 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 maximum 1-inch.

3.10 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.

B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.11 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:
   1. Exterior Concrete Walls above Grade:
      a. Piping Smaller Than NPS 6: Steel pipe sleeves or sleeve-seal fittings.
      b. Piping NPS 6 and Larger: Steel pipe sleeves or sleeve-seal fittings.
   2. Exterior Concrete Walls below Grade:
      a. Piping Smaller Than NPS 6: Steel pipe sleeves with sleeve-seal system, or sleeve-seal fittings.
         1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
      b. Piping NPS 6 and Larger: Steel pipe sleeves with sleeve-seal system, or sleeve-seal fittings.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:
   a. Piping Smaller Than NPS 6: Steel pipe sleeves with sleeve-seal system, or sleeve-seal fittings.
      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
   b. Piping NPS 6 and Larger: Steel pipe sleeves with sleeve-seal system, or sleeve-seal fittings.
      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
4. Concrete Slabs above Grade:
   a. Piping Smaller Than NPS 6: Steel pipe sleeves or sleeve-seal fittings.
   b. Piping NPS 6 and Larger: Steel pipe sleeves.
5. Interior Partitions:
   a. Piping Smaller Than NPS 6: Steel pipe sleeves.
   b. Piping NPS 6 and Larger: Galvanized-steel sheet sleeves.

3.12 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with NFPA requirements for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.

G. Horizontal-Piping Hangers and Supports: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of stationary pipes NPS 1/2 to NPS 30.
   2. Steel Pipe Clamps (MSS Type 4): For suspension of NPS 1/2 to NPS 24 if little or no insulation is required.
   3. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of stationary pipes NPS 1/2 to NPS 8.
   4. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of stationary pipes NPS 3/8 to NPS 8.
   5. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of stationary pipes NPS 3/8 to NPS 3.

6. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
7. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
8. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
9. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

H. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

I. Hanger-Rod Attachments: Comply with NFPA requirements.

J. Building Attachments: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. C-Clamps (MSS Type 23): For structural shapes.
3. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

K. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 210500

SECTION 210523 - GENERAL-DUTY VALVES FOR FIRE PROTECTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Two-piece ball valves with indicators.
2. Bronze butterfly valves with indicators.
3. Iron butterfly valves with indicators.
4. Check valves.
5. Bronze OS&Y gate valves.
6. Iron OS&Y gate valves.
7. NRS gate valves.
8. Trim and drain valves.

1.3 DEFINITIONS

A. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

B. NRS: Nonrising stem.

C. OS&Y: Outside screw and yoke.

D. SBR: Styrene-butadiene rubber.

1.4 ACTION SUBMITTALS

A. Refer to Section 210500 "Common Work Results for Fire Protection" for action submittal requirements.

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, and weld ends.
3. Set valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

D. Protect flanges and specialties from moisture and dirt.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" under the headings listed below and shall bear UL mark:
1. Main Level: HAMV - Fire Main Equipment.
    a. Level 1: HCBZ - Indicator Posts, Gate Valve.
    b. Level 1: HLOT - Valves.
        1) Level 3: HLUG - Ball Valves, System Control.
        2) Level 3: HLXS - Butterfly Valves.
        3) Level 3: HMER - Check Valves.
        4) Level 3: HMRZ - Gate Valves.
2. Main Level: VDGT - Sprinkler System & Water Spray System Devices.
    a. Level 1: VQGU - Valves, Trim and Drain.

B. FM Global Approved: Valves shall be listed in its "Approval Guide," under the headings listed below:
1. Automated Sprinkler Systems:
    a. Indicator posts.
    b. Valves.
        1) Gate valves.
        2) Check valves.
            a) Single check valves.
        3) Miscellaneous valves.

C. Source Limitations for Valves: Obtain valves for each valve type from single manufacturer.

D. ASME Compliance:
1. ASME B16.1 for flanges on iron valves.
2. ASME B1.20.1 for threads for threaded-end valves.
3. ASME B31.9 for building services piping valves.

E. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

F. NFPA Compliance: Comply with NFPA 24 for valves.

G. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher as required by system pressures.

H. Valve Sizes: Same as upstream piping unless otherwise indicated.

I. Valve Actuator Types:
1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
2. Handwheel: For other than quarter-turn trim and drain valves.
3. Handlever: For quarter-turn trim and drain valves NPS 2 and smaller.

2.2 TWO-PIECE BALL VALVES WITH INDICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Nibco, Inc..
2. Victaulic Company.

B. Description:
1. UL 1091, except with ball instead of disc and FM Global standard for indicating valves (butterfly or ball type), Class Number 1112.
2. Minimum Pressure Rating: 175 psig.
3. Body Design: Two piece.
4. Body Material: Forged brass or bronze.
5. Port Size: Full or standard.
6. Seats: PTFE.
7. Stem: Bronze or stainless steel.
8. Ball: Chrome-plated brass.
9. Actuator: Worm gear or traveling nut.
10. End Connections for Valves NPS 1 through NPS 2: Threaded ends.
11. End Connections for Valves NPS 2-1/2: Grooved ends.

2.3 BRONZE BUTTERFLY VALVES WITH INDICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Fivalco Inc.
2. Globe Fire Sprinkler Corporation
3. Milwaukee Valve Company

B. Description:
1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 1112.
2. Minimum: Pressure rating: 175 psig.
3. Body Material: Bronze.
4. Seat Material: EPDM.
5. Stem Material: Bronze or stainless steel.
6. Disc: Stainless steel with EPDM coating.

7. Actuator: Worm gear or traveling nut.
8. Ends Connections for Valves NPS 1 through NPS 2: Threaded ends.
9. Ends Connections for Valves NPS 2-1/2: Grooved ends.

2.4 IRON BUTTERFLY VALVES WITH INDICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Anvil International
2. Fivalco Inc.
3. Globe Fire Sprinkler Corporation
4. Kennedy Valve Company; a division of McWane, Inc.
5. NIBCO INC.
6. Tyco Fire Products LP
7. Victaulic Company
8. Zurn Industries, LLC

B. Description:
1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 112.
2. Minimum Pressure Rating: 175 psig.
3. Body Material: Cast or ductile iron.
4. Seat Material: EPDM.
5. Stem: Stainless steel.
6. Disc: Ductile iron, and EPDM or SBR coated.
7. Actuator: Worm gear or traveling nut.
8. Body Design: Lug or wafer.

2.5 CHECK VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Anvil International
2. Fire Protection Products, Inc
3. Fivalco Inc.
4. Globe Fire Sprinkler Corporation
5. Kennedy Valve Company; a division of McWane, Inc.
6. Mueller Co
7. NIBCO INC.
8. Reliable Automatic Sprinkler Co., Inc. (The)
9. Shurjoint Piping Products USA Inc
10. Tyco Fire Products LP
11. Victaulic Company
12. Viking Corporation
13. WATTS
14. Zurn Industries, LLC

B. Description:

1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
2. Minimum Pressure Rating: 175 psig.
3. Type: Single swing check.
4. Body Material: Cast iron, ductile iron, or bronze.
5. Clapper: Bronze, ductile iron, or stainless steel.
6. Clapper Seat: Brass, bronze, or stainless steel.
7. Hinge Shaft: Bronze or stainless steel.
8. Hinge Spring: Stainless steel.
9. End Connections: Flanged, grooved, or threaded.

2.6 BRONZE OS&Y GATE VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Milwaukee Valve Company
2. NIBCO INC.
3. United Brass Works, Inc
4. Zurn Industries, LLC

B. Description:
1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Bronze or brass.
4. Wedge: One-piece bronze or brass.
5. Wedge Seat: Bronze.
6. Stem: Bronze or brass.
7. Packing: Non-asbestos PTFE.
8. End Connections: Threaded.

2.7 IRON OS&Y GATE VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Cast Iron Pipe Company
2. Clow Valve Company; a subsidiary of McWane, Inc.
3. Hammond Valve
4. Kennedy Valve Company; a division of McWane, Inc.
5. Mueller Co
6. NIBCO INC.
7. Victaulic Company
8. WATTS
9. Zurn Industries, LLC

B. Description:
1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.

3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron, or bronze.
5. Wedge Seat: Cast or ductile iron, or bronze.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. End Connections: Flanged or grooved.

2.8 NRS GATE VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Cast Iron Pipe Company
2. Clow Valve Company; a subsidiary of McWane, Inc.
3. Kennedy Valve Company; a division of McWane, Inc.
4. Mueller Co
5. NIBCO INC.
6. Victaulic Company
7. Zurn Industries, LLC

B. Description:
1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron.
5. Wedge Seat: Cast or ductile iron, or bronze.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. End Connections: Flanged or grooved.

2.9 TRIM AND DRAIN VALVES

A. Ball Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Fire Protection Products, Inc
c. Milwaukee Valve Company
d. NIBCO INC.
e. Potter Roemer LLC
f. Tyco Fire Products LP
g. Victaulic Company
h. WATTS
i. Zurn Industries, LLC
2. Description:
a. Pressure Rating: 175 psig.
b. Body Design: Two piece.
c. Body Material: Forged brass or bronze.

d. Port size: Full or standard.
e. Seats: PTFE.
f. Stem: Bronze or stainless steel.
g. Ball: Chrome-plated brass.
h. Actuator: Handlever.
i. End Connections for Valves NPS 1 through NPS 2-1/2: Threaded ends.
j. End Connections for Valves NPS 1-1/4 and NPS 2-1/2: Grooved ends.

B. Automatic (Ball Drip) Drain Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Kidde Fire Fighting
b. Reliable Automatic Sprinkler Co., Inc. (The)
c. Tyco Fire Products LP
2. Standard: UL 1726.
3. Pressure Rating: 175 psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

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 GENERAL REQUIREMENTS FOR VALVE INSTALLATION

A. Comply with requirements in the following Sections for specific valve installation requirements and applications:
1. Section 211313 "Wet-Pipe Sprinkler Systems" for application of valves in wet-pipe, fire-suppression sprinkler systems.
2. Section 211316 "Dry-Pipe Sprinkler Systems" for application of valves in dry-pipe, fire-suppression sprinkler systems.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above the pipe center.

E. Install valves in position to allow full stem movement.

F. Install valve tags. Comply with the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.

G. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections.

H. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

END OF SECTION 210523

SECTION 210548 - SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Restraint channel bracings.
   2. Seismic-restraint accessories.
   3. Mechanical anchor bolts.
   4. Adhesive anchor bolts.

B. Related Requirements:

   1. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for devices for plumbing equipment and systems.
   2. Section 230548 "Vibration and Seismic Controls for HVAC" for devices for HVAC equipment and systems.

1.3 DEFINITIONS

A. ASCE/SEI: American Society of Civil Engineers/Structural Engineering Institute.

B. IBC: International Building Code.

C. ICC-ES: ICC-Evaluation Service.

D. OSHPD: Office of Statewide Health Planning & Development (for the State of California).

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
   2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.
      a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction.

b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.

1. Include design calculations and details for selecting vibration isolators and seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, due to seismic forces required to select vibration isolators, and due to seismic restraints.
3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
4. Seismic-Restraint Details:
   a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
   b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
   c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
   d. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for fire-suppression piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For professional engineer and testing agency.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:
1. Refer to structural drawings for seismic information and factors.
2. Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction.
   a. 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 are subjected.

2.2 RESTRAINT CHANNEL BRACINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. B-line, an Eaton business
2. Hilti, Inc.
3. Mason Industries, Inc.
4. Unistrut; Part of Atkore International

B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.3 SEISMIC-RESTRAINT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. B-line, an Eaton business

2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.
4. Novia; A Division of C&P
5. TOLCO
6. Vibration & Seismic Technologies, LLC

B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.4 MECHANICAL ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. B-line, an Eaton business
2. Hilti, Inc.
3. Kinetics Noise Control, Inc.
4. Mason Industries, Inc.

B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

C. Expansion-type anchor bolts are not permitted by ASCE/SEI 7 for nonisolated equipment in excess of 10 hp.

2.5 ADHESIVE ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hilti, Inc.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.

B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive.

Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

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

3.2 APPLICATIONS

A. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

B. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Division 03.

B. Installation of seismic restraints must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Equipment Restraints:
1. Install seismic snubbers on fire protection equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction that provides required submittals for component.

D. Piping Restraints:

1. Comply with requirements in NFPA and MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

E. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction that provides required submittals for component.

F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

G. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

H. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

I. Drilled-in Anchors:
1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 211200 "Fire-Suppression Standpipes," Section 211313 "Wet-Pipe Sprinkler Systems," and Section 211316 "Dry-Pipe Sprinkler Systems" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:
   1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
   2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
   3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
   4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
   5. Test to 90 percent of rated proof load of device.
   6. Measure isolator restraint clearance.
   7. Measure isolator deflection.
   8. Verify snubber minimum clearances.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

END OF SECTION 210548

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Pipes, fittings, and specialties.
2. Specialty valves.
3. Sprinklers.
4. Alarm devices.
5. Pressure gages.

B. Related Requirements:
1. Section 210500 "Common Work Results for Fire Protection" for additional submittal requirements.
2. Section 230523 "General-Duty Valves Fire Protection Piping" for ball, butterfly, check, gate, post-indicator, and trim and drain valves.

1.3 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

1.4 ACTION SUBMITTALS

A. Refer to Section 210500 "Common Work Results for Fire Protection" for additional submittal requirements.

B. Product Data: For each type of product.
1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

C. Shop Drawings: For wet-pipe sprinkler systems.
1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

D. Delegated-Design Submittal: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified licensed fire sprinkler contractor responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 210500 "Common Work Results for Fire Protection" for additional submittal requirements.

B. Qualification Data: For licensed fire sprinkler contractor.

C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations.

D. Field Test Reports: 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."

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems. Base calculations on results of fire-hydrant flow test.
      a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified licensed fire sprinkler contractor.

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. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with NFPA 13.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with NFPA 13.

B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

C. Design sprinkler system, including comprehensive engineering analysis by a qualified professional engineer or licensed fire sprinkler contractor, using performance requirements and design criteria indicated.
1. Refer to drawings and Fire Sprinkler System Specification Sheet.

D. Pipe sizes shall be as required by NFPA Standards but in no case less than those shown on the drawings or specified.

E. Sprinkler system design shall be approved by authorities having jurisdiction.

F. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.

G. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

2.2 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials and for joining methods for specific services, service locations, and pipe sizes

B. All pipe and fittings shall be from a domestic manufacturer.

2.3 BLACK STEEL PIPE AND ASSOCIATED FITTINGS

A. Schedule 40: ASTM A 53/A 53M, Type E; with factory- or field-formed ends to accommodate joining method.

B. Schedule 10: ASTM A 135/A 135M or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.

C. Uncoated, Steel Couplings: ASTM A 865/A 865M, threaded.

D. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

E. Malleable- or Ductile-Iron Unions: UL 860.

F. Cast-Iron Flanges: ASME B16.1, Class 125.

G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

H. Grooved-Joint, Steel-Pipe Appurtenances:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Anvil International
b. Corcoran Piping System Co.
c. National Fittings, Inc
d. Shurjoint Piping Products USA Inc
e. Smith-Cooper International
f. Tyco Fire Products LP
g. Victaulic Company
2. Pressure Rating: 175 psig minimum.
3. Galvanized and Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
5. Where flexible couplings are required by NFPA, they shall be Victaulic style 75 flexible couplings or approved equal.

2.4 GALVANIZED-STEEL PIPE AND ASSOCIATED FITTINGS

A. Schedule 40: ASTM A 53/A 53M, Type E, Grade B; with factory- or field-formed ends to accommodate joining method.

B. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Standard Weight, seamless steel pipe with threaded ends.

C. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

D. Malleable-Iron Unions:
1. ASME B16.39, Class 150.
2. Hexagonal-stock body.
3. Ball-and-socket, metal-to-metal, bronze seating surface.
4. Threaded ends.

E. Flanges: ASME B16.1, Class 125, cast iron.

F. Appurtenances for Grooved-End, Galvanized-Steel Pipe:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Anvil International
b. Grinnell Mechanical Products
c. Shurjoint Piping Products USA Inc
d. Victaulic Company

2. Fittings for Grooved-End, Galvanized-Steel Pipe: Galvanized, ASTM A 47/A 47M, malleable-iron casting; ASTM A 106/A 106M, steel pipe; or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
3. Fittings for Grooved-End, Galvanized-Steel Pipe:
   a. AWWA C606 for steel-pipe dimensions.
   b. Ferrous housing sections.
   c. EPDM-rubber gaskets suitable for hot and cold water.
   d. Bolts and nuts.
   e. Minimum Pressure Rating:
      1) NPS 8 and Smaller: 600 psig.
      2) NPS 10 and NPS 12: 400 psig.
      3) NPS 14 to NPS 24: 250 psig.

2.5 SPECIALTY VALVES

A. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing or FM Global's "Approval Guide."
2. Pressure Rating:
   a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Globe Fire Sprinkler Corporation
   b. Kidde Fire Fighting
   c. Reliable Automatic Sprinkler Co., Inc. (The)
   d. Tyco Fire Products LP
   e. Venus Fire Protection Ltd.
   f. Victaulic Company
   g. Viking Corporation
2. Standard: UL 193.
3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, and fill-line attachment with strainer.
5. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. Deluge Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Globe Fire Sprinkler Corporation
   b. Kidde Fire Fighting
   c. Reliable Automatic Sprinkler Co., Inc. (The)
   d. Tyco Fire Products LP
   e. Venus Fire Protection Ltd.
   f. Victaulic Company

g. Viking Corporation
2. Standard: UL 260.
3. Design: Hydraulically operated, differential-pressure type.
4. Include trim sets for alarm-test bypass, drain, electrical water-flow alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, and fill-line attachment with strainer.
5. Wet, Pilot-Line Trim Set: Include gage to read diaphragm-chamber pressure and manual control station for manual operation of deluge valve, and connection for actuation device.

D. Automatic (Ball Drip) Drain Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Reliable Automatic Sprinkler Co., Inc. (The)
b. Tyco Fire Products LP
2. Standard: UL 1726.
3. Pressure Rating: 175-psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

2.6 SPRINKLER PIPING SPECIALTIES

A. General Requirements for Wet-Pipe System Fittings: UL listed for wet-pipe service.

B. In-Building Riser:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Ames Fire & Waterworks
2. Description: Single extended 90-degree fitting which passes under the foundation and extends up through the floor without joints to connect the main fire supply to the building overhead fire system.
3. Standard: NFPA 24, UL/FM approved.
4. Material: Type 304 stainless steel tubing.
5. Pressure Rating: 175-psig minimum.
6. Configuration: Grooved-end connection on the outlet (building) side and CIPS coupler on the underground (inlet) side.
7. Accessories:
a. Grooved end shall include a coupler and cap to facilitate testing of the underground piping.
b. Vertical and horizontal leg shall be as required to make building side and underground connections.

C. Branch Outlet Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Anvil International, Inc.
b. National Fittings, Inc.
c. Tyco Fire & Building Products LP.
d. Victaulic Company.

2. Standard: UL 213.
3. Pressure Rating: 175-psig minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-tee and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

D. Flow Detection and Test Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AGF Manufacturing, Inc.
   b. Reliable Automatic Sprinkler Co., Inc. (The)
   c. Tyco Fire Products LP
   d. Victaulic Company
2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
3. Pressure Rating: 175-psig minimum.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded or grooved.

E. Branch Line Testers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AGF Manufacturing, Inc.
   b. Elkhart Brass Mfg. Co., Inc
   c. Fire-End & Croker Corporation
   d. Potter Electric Signal Company, LLC
   e. Potter Roemer LLC
2. Standard: UL 199.
3. Pressure Rating: 175 psig.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

F. Sprinkler Inspector's Test Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AGF Manufacturing, Inc.
   b. Tyco Fire Products LP
   c. Victaulic Company
   d. Viking Corporation
2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
3. Pressure Rating: 175-psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.

6. Inlet and Outlet: Threaded.

G. Adjustable Drop Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Aegis Technologies, Inc.
b. CECA, LLC
c. Corcoran Piping System Co.
d. Merit Manufacturing
2. Standard: UL 1474.
3. Pressure Rating: 250-psig minimum.
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

H. Flexible Sprinkler Hose Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. FlexHead Industries, Inc.
b. Reliable Automatic Sprinkler Co., Inc.
c. Victaulic Company
2. Standard: UL 1474.
3. Type: Flexible braided hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175-psig minimum.
5. Size: Same as connected piping, for sprinkler.

2.7 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Globe Fire Sprinkler Corporation
2. Reliable Automatic Sprinkler Co., Inc. (The)
3. Tyco Fire Products LP
4. Victaulic Company
5. Viking Corporation

B. General Requirements:
1. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
2. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:
1. Early-Suppression, Fast-Response Applications: UL 1767.
2. Nonresidential Applications: UL 199.
3. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:
   1. Chrome plated
   2. Bronze
   3. Painted.

E. Special Coatings:
   1. Wax
   2. Lead
   3. Corrosion-resistant paint.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
   1. Ceiling Mounting: Chrome-plated steel, one piece, flat.
   2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

G. Sprinkler Guards:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Reliable Automatic Sprinkler Co., Inc. (The)
      b. Tyco Fire Products LP
      c. Victaulic Company
      d. Viking Corporation
   2. Standard: UL 199.
   3. Type: Wire cage with fastening device for attaching to sprinkler.

2.8 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

2.9 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AMETEK, Inc.
   2. Ashcroft Inc
   3. Brecco Corporation
   4. WIKA Instrument Corporation

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gage Range: 0- to 250-psig minimum.

E. Label: Include "WATER" label on dial face.

PART 3 - EXECUTION

3.1 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building.

B. Install shutoff valve, pressure gage, drain, and other accessories indicated at connection to water-service piping.

3.2 GENERAL INSTALLATION

A. Prior to submitting the sprinkler shop drawings, the Contractor shall meet with the Architect and thoroughly review the pipe routing, elevations, sprinkler locations, and method of installation for all exposed piping.

B. Any facet of sprinkler installation that does not meet with the Architect's approval shall be revised by the Contractor to the Architect 's satisfaction at no expense to the Owner.

C. Piping installed under this Section shall be coordinated with that of all other Sections and trades so that all work may be installed in the most direct and workmanlike manner and so that interference between piping, ducts, equipment, electrical, architectural and structural features will be avoided.

3.3 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
   1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
   2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
   3. Exposed piping shall be installed as high as possible, but no less than 7'-6" above the finished floor. Piping shall not obstruct any portion of a window, doorway, stairway or passageway, and shall not interfere with the installation, operation or accessibility of any mechanical, plumbing, or electrical equipment.
      a. Exposed piping shall be installed a minimum 8'-2" above the finished floor in areas of pedestrian and vehicular routes to, and clearance within, accessible parking spaces.

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Furnish in-building riser to civil site contractor for installation as part of the underground fire-suppression water-service piping.

D. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.

E. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

F. Install unions adjacent to each valve in pipes NPS 2 and smaller.

G. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

H. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

I. Install sprinkler piping with drains for complete system drainage.

J. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

K. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

L. Install alarm devices in piping systems.

M. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13. In seismic-rated areas, refer to Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."

N. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they are not subject to freezing.

O. Main, low point and inspector drains be hard-piped to the exterior. Location shall be indicated on the shop drawing submittal and coordinated with the architect. A concrete splashblock shall be provided at drain discharge locations areas without concrete or asphalt.

P. Fill sprinkler system piping with water.

Q. Install sleeves for piping penetrations of walls, ceilings, and floors.

R. Install sleeve seals for piping penetrations of exterior concrete walls and slabs.

S. Install escutcheons for exposed piping penetrations of finished walls, ceilings, and floors.

3.4 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.5 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:
   1. Install valves in vertical position for proper direction of flow, in main supply to system.
   2. Install alarm valves with bypass check valve and retarding chamber drain-line connection.

3.6 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space in areas subject to freezing, such as freezer boxes and at loading docks. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.7 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals.

C. Risers be tagged with metal riser hydraulic data plates. Stick-on labels are not permitted. Hydraulic design information on data plates shall be stamped. Permanent marker is not permitted.

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Coordinate with fire-pump tests. Operate as required.
7. Verify that equipment hose threads are same as local fire department equipment.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.10 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.11 PIPING SCHEDULE

A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be the following:
   1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.

D. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 and larger, shall be the following:
   1. Schedule 10, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.12 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications, unless otherwise indicated:
   1. Rooms without Ceilings: Upright sprinklers.
   2. Rooms with Suspended Ceilings: Concealed sprinklers.
   3. Rooms with Gypsum Ceilings: Concealed sprinklers.
   4. Wall Mounting: Sidewall sprinklers.
   5. Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers as indicated.
   6. Spaces Subject to High Heat: Provide 212°F intermediate temperature classified heads.
   7. Elevator Equipment Rooms: Provide 212°F intermediate temperature classified heads.
   8. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated.

B. Provide sprinkler types in subparagraphs below with finishes indicated.
   1. Concealed Sprinklers: Rough brass, with factory-painted cover plate to match the color of the ceiling.
   2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
   3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
   4. Upright, Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.
   5. Indicate sprinkler head and concealed cover colors on shop drawings.

C. The correct temperature rating of every sprinkler head shall be used according to the maximum ceiling temperature rating and requirements in NFPA 13. All sprinklers with the exception of

specified decorative types and bulb type sprinklers shall have their frame arms colored at the factory in accordance with the standard table in NFPA 13. High temperature heads shall be used where required by NFPA 13 and the AHJ.

D. Sprinklers that may be subject to mechanical damage due to their location (under stairwells, or low hanging sprinklers in corridors, storage rooms or under ducts) shall be provided with approved guards. Sprinklers under open gratings shall be provided with approved shields.

3.13 FIELD PAINTING

A. Painting of sprinkler systems above suspended ceilings is not required.

B. Clean, prime, and paint exposed sprinkler system piping, valves, hangers, accessories, and miscellaneous metal work. Refer to Division 09.

C. Clean surfaces prior to painting. Immediately after cleaning, prime metal surfaces with SSPC Paint 25 or SSPC Paint 25 metal primer applied to a minimum dry film thickness of 0.04 mm 1.5 mils.

D. Exercise care to avoid painting sprinkler heads and operating devices.

E. Upon completion of painting, remove materials which were used to protect sprinkler heads and operating devices which have been inadvertently painted and provide new clean sprinkler heads and operating devices of the proper type. Finish primed surfaces as follows:
   1. Systems in Finished Areas
      a. Finished areas are defined as areas where walls or ceilings are painted or are constructed of a prefinished material. Paint primed surfaces with two coats of paint to match adjacent surfaces.
   2. Systems in Unfinished Areas
      a. Paint piping in valve rooms, and mechanical rooms with CID A-A-2962 gloss red enamel applied to a minimum dry film thickness of 0.04 mm 1.6 mils.

END OF SECTION 211313

SECTION 211316 - DRY-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Pipes, fittings, and specialties.
2. Specialty valves.
3. Sprinkler piping specialties.
4. Sprinklers.
5. Control panels.
6. Pressure gages.

B. Related Requirements:
1. Section 210500 "Common Work Results for Fire Protection" for additional submittal requirements.
2. Section 230523 "General-Duty Valves for Water-Based Fire-Suppression Piping" for ball, butterfly, check, gate, post-indicator, and trim and drain valves.

1.3 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Dry-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

1.4 ACTION SUBMITTALS

A. Refer to Section 210500 "Common Work Results for Fire Protection" for additional submittal requirements.

B. Product Data: For each type of product.
1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

C. Shop Drawings: For dry-pipe sprinkler systems.
1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

D. Delegated-Design Submittal: For dry-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified licensed fire sprinkler contractor responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 210500 "Common Work Results for Fire Protection" for additional submittal requirements.

B. Qualification Data: For licensed fire sprinkler contractor.

C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations.

D. Field Test Reports: 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."

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For dry-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

   1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
      a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified licensed fire sprinkler contractor.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTIONS

A. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from opened sprinklers.

B. Combined Dry-Pipe and Preaction Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Fire-detection system, located in same area as sprinklers, actuates tripping devices that open dry-pipe valve without loss of air pressure and actuates fire alarm. Water discharges from opened sprinklers.

C. Single-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of fire-detection system, located in same area as sprinklers, opens deluge valve, permitting water to flow into sprinkler piping and to discharge from opened sprinklers.

D. Double-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of a fire-detection system, located in same area as sprinklers, opens deluge valve, permitting water to flow into sprinkler piping. A closed solenoid valve in the sprinkler piping is opened by another fire-detection device; water will then discharge from opened sprinklers.

2.2 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with NFPA 13.

C. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

D. Design sprinkler system, including comprehensive engineering analysis by a qualified professional engineer or licensed fire sprinkler contractor, using performance requirements and design criteria indicated.
   1. Refer to drawings and Fire Sprinkler System Specification Sheet.

E. Pipe sizes shall be as required by NFPA Standards but in no case less than those shown on the drawings or specified.

F. Sprinkler system design shall be approved by authorities having jurisdiction.

G. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.

H. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

2.3 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials and for joining methods for specific services, service locations, and pipe sizes.

B. All pipe and fittings shall be from a domestic manufacturer.

2.4 STEEL PIPE AND FITTINGS

A. Schedule 40 (Standard-Weight) Steel Pipe: Galvanized- and black-steel pipe, ASTM A53/A53M, Type E, Grade B or ASTM A795/A795M Type E, Grade A. Pipe ends may be factory or field formed to match joining method.

B. Steel Pipe Nipples: Galvanized and black steel, ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends.

C. Steel Couplings: Galvanized and uncoated steel, ASTM A865/A865M, threaded.

D. Gray-Iron Threaded Fittings: Galvanized and uncoated gray-iron threaded fittings, ASME B16.4, Class 125, standard pattern.

E. Malleable- or Ductile-Iron Unions: UL 860.

F. Cast-Iron Flanges: ASME 16.1, Class 125.

G. Grooved-Joint, Steel-Pipe Appurtenances:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil International
      b. Corcoran Piping System Co.
      c. National Fittings, Inc
      d. Shurjoint Piping Products USA Inc
      e. Smith-Cooper International
      f. Tyco Fire Products LP
      g. Victaulic Company
   2. Pressure Rating: 175-psig minimum.
   3. Grooved-End Fittings for Steel Piping: Galvanized grooved-end fittings, ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.
   4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.5 SPECIALTY VALVES

A. General Requirements:
   1. Standard: UL's "Fire Protection Equipment Directory" listing or FM Global's "Approval Guide."
   2. Pressure Rating:
      a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
   3. Body Material: Cast or ductile iron.
   4. Size: Same as connected piping.
   5. End Connections: Flanged or grooved.

B. Dry-Pipe Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Globe Fire Sprinkler Corporation
      b. Reliable Automatic Sprinkler Co., Inc. (The)
      c. Tyco Fire Products LP
      d. Venus Fire Protection Ltd.
      e. Victaulic Company
      f. Viking Corporation
   2. Standard: UL 260.
   3. Design: Differential-pressure type.
   4. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
   5. Air Compressor:
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Gast Manufacturing Inc
         2) General Air Products, Inc
         3) Viking Corporation
      b. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
      c. Motor Horsepower: Fractional.
      d. Power: 120-V ac, 60 Hz, single phase.
         1) compressor.

2.6 SPRINKLER PIPING SPECIALTIES

A. General Requirements for Dry-Pipe System Fittings: UL listed for dry-pipe service.

B. Branch Outlet Fittings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil International, Inc.
      b. National Fittings, Inc.
      c. Tyco Fire & Building Products LP.
      d. Victaulic Company.
   2. Standard: UL 213.

3. Pressure Rating: 175-psig minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-tee and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

C. Flow Detection and Test Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AGF Manufacturing, Inc.
   b. Reliable Automatic Sprinkler Co., Inc. (The)
   c. Tyco Fire Products LP
   d. Victaulic Company
2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
3. Pressure Rating: 175-psig minimum.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded or grooved.

D. Branch Line Testers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AGF Manufacturing, Inc.
   b. Elkhart Brass Mfg. Co., Inc
   c. Fire-End & Croker Corporation
   d. Potter Electric Signal Company, LLC
   e. Potter Roemer LLC
2. Standard: UL 199.
3. Pressure Rating: 175 psig.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

E. Sprinkler Inspector's Test Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AGF Manufacturing, Inc.
   b. Tyco Fire Products LP
   c. Victaulic Company
   d. Viking Corporation
2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
3. Pressure Rating: 175-psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

F. Adjustable Drop Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Aegis Technologies, Inc.
   b. CECA, LLC
   c. Corcoran Piping System Co.
   d. Merit Manufacturing
2. Standard: UL 1474.
3. Pressure Rating: 250-psig minimum.
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

G. Flexible Sprinkler Hose Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. FlexHead Industries, Inc.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Victaulic Company
2. Standard: UL 1474.
3. Type: Flexible braided hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175-psig minimum.
5. Size: Same as connected piping, for sprinkler.

2.7 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Globe Fire Sprinkler Corporation
2. Reliable Automatic Sprinkler Co., Inc. (The)
3. Tyco Fire Products LP
4. Victaulic Company
5. Viking Corporation

B. General Requirements:
1. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
2. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:
1. Nonresidential Applications: UL 199.
2. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:
1. Chrome plated
2. Bronze

3. Painted.

E. Special Coatings:
1. Wax
2. Lead
3. Corrosion-resistant paint.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
1. Ceiling Mounting: Chrome-plated steel, one piece, flat.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

G. Sprinkler Guards:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Reliable Automatic Sprinkler Co., Inc. (The)
b. Tyco Fire Products LP
c. Victaulic Company
d. Viking Corporation
2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

2.8 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

2.9 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AMETEK, Inc.
2. Ashcroft Inc
3. Brecco Corporation
4. WIKA Instrument Corporation

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gage Range: 0- to 250-psig minimum.

E. Label: Include "WATER" or "AIR/WATER" label on dial face.

F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building.

B. Install shutoff valve, pressure gage, drain, and other accessories indicated at connection to water-service piping.

3.2 GENERAL INSTALLATION

A. Prior to submitting the sprinkler shop drawings, the Contractor shall meet with the Architect and thoroughly review the pipe routing, elevations, sprinkler locations, and method of installation for all exposed piping.

B. Any facet of sprinkler installation that does not meet with the Architect 's approval shall be revised by the Contractor to the Architect 's satisfaction at no expense to the Owner.

C. Piping installed under this Section shall be coordinated with that of all other Sections and trades so that all work may be installed in the most direct and workmanlike manner and so that interference between piping, ducts, equipment, electrical, architectural and structural features will be avoided.

3.3 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
   1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
   2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
   3. Exposed piping shall be installed as high as possible, but no less than 7'-6" above the finished floor. Piping shall not obstruct any portion of a window, doorway, stairway or passageway, and shall not interfere with the installation, operation or accessibility of any mechanical, plumbing, or electrical equipment.
      a. Exposed piping shall be installed a minimum 8'-2" above the finished floor in areas of pedestrian and vehicular routes to, and clearance within, accessible parking spaces.

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Furnish in-building riser to civil site contractor for installation as part of the underground fire-suppression water-service piping.

D. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.

E. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

F. Install unions adjacent to each valve in pipes NPS 2 and smaller.

G. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

H. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

I. Install sprinkler piping with drains for complete system drainage.

J. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

K. Install automatic (ball drip) drain valves to drain piping between fire department connections and check valves. Drain to floor drain or to outside building.

L. Connect air compressor to the following piping and wiring:

1. Pressure gages and controls.
2. Electrical power system.
3. Fire-alarm devices, including low-pressure alarm.

M. Install alarm devices in piping systems.

N. Install hangers and supports for sprinkler system piping according to NFPA 13.

O. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they are not subject to freezing.

P. Drain dry-pipe sprinkler piping.

Q. Pressurize and check dry-pipe sprinkler system piping and air compressors.

R. Install sleeves for piping penetrations of walls, ceilings, and floors.

S. Install sleeve seals for piping penetrations of exterior concrete walls and slabs.

T. Install escutcheons for exposed piping penetrations of finished walls, ceilings, and floors.

3.4 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

I. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.5 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:
1. Install valves in vertical position for proper direction of flow, in main supply to system.
2. Install dry-pipe and deluge valves with trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
    a. Install air compressor and compressed-air-supply piping.

3.6 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Install sprinklers with water supply from heated space. Do not install pendent or sidewall sprinklers in areas subject to freezing.

C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.7 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals.

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Start and run air compressors.
6. Coordinate with fire-alarm tests. Operate as required.
7. Coordinate with fire-pump tests. Operate as required.
8. Verify that equipment hose threads are same as local fire department equipment.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.10 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.11 PIPING SCHEDULE

A. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

B. Standard-Pressure, Dry-Pipe Sprinkler System, NPS 2 and smaller, shall be the following:

1. Schedule 40 (Standard-Weight), galvanized-steel pipe with threaded ends; gray-iron threaded fittings; and threaded joints

C. Standard-Pressure, Dry-Pipe Sprinkler System, NPS 2-1/2 and larger, shall be the following:
1. Schedule 40 (Standard-Weight), galvanized-steel pipe with roll-grooved ends; grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.12 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:
1. Outside spaces with ceilings: Concealed sprinklers.
2. Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers as indicated.

B. Provide sprinkler types in subparagraphs below with finishes indicated.
1. Concealed Sprinklers: Rough brass, with factory-painted cover plate to match the color of the ceiling.
2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
4. Upright, Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211316

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

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 describes the common work requirements for the plumbing work included in Division 22 and applies to all sections of Division 22.

B. Related Sections:
   1. Section 013150 "Coordination Drawings" for coordination drawing requirements.

1.3 SUSTAINABLE DESIGN REQUIREMENTS – GREEN GLOBES

A. The Owner is pursuing Green Building Initiative (GBI) Green Globes for New Construction (NC) Certification.

B. Submit documentation to GBI-authorized Assessor and respond to questions and requests from GBI-authorized Assessor about Green Globes credits that are the responsibility of Contractor, that depend on product selection or product qualities, or that depend on Contractor's procedures until GBI-authorized Assessor has made its determination on Project's Green Globes certification application.
   1. Document correspondence with GBI-authorized Assessor as informational submittals.

C. Refer to the Division 1 sustainable design requirements for additional information.

1.4 COMMISSIONING

A. The Owner is pursuing Green Building Initiative (GBI) Green Globes for New Construction (NC) Certification. The scope of the commissioning effort is that which is required to facilitate fulfilling Fundamental Commissioning of the Building Energy Systems and Enhanced Commissioning.

B. All building energy-related systems shall be commissioned in order to verify and ensure that fundamental building elements and systems are installed, constructed, calibrated to operate, and perform according to the Owner's Project Requirements, Basis of Design, and Construction Documents.

C. Refer to the Divisions 1 and 22 commissioning specifications for additional information.

1.5 DEFINITIONS

A. Following are definitions of terms and expressions used in the Mechanical and Electrical Sections:
   1. Provide: Furnish and install
   2. Directed: Directed by the Architect or Engineer
   3. Indicated: Indicated in Contract Documents
   4. Concealed: Hidden from normal sight; includes items within furred spaces, pipe and duct shafts, above suspended ceilings and within return air plenums.
   5. Exposed: Non-concealed - Work within Equipment Rooms shall be considered exposed.
   6. Exterior: Items being or situated outside. Items located within a crawl space shall be considered exterior.
   7. Conditioned: Heated or cooled space, or both, within a building and, where required, provided with humidification or dehumidification means, so as to be capable of maintaining a space condition falling within the comfort envelope set forth in ASHRAE 55.
   8. Piping: Includes pipes, fittings, valves, hangers, and accessories comprising a system.
   9. Architect: Principal design professional for the project. In certain types of projects, the principal design professional may be an engineer rather than an architect. For such projects, within the bounds of these specifications, where the term "architect" is used, it may refer instead to the engineer.

1.6 CODES, REGULATIONS, AND PERMITS:

A. References to codes, standards, specifications, and regulations apply to the latest edition adopted by the jurisdiction where the project is located.

B. All materials furnished and all work installed shall comply with the applicable rules, regulations, and recommendations of the following bodies:
   1. International Building Code
   2. International Existing Building Code
   3. International Mechanical Code
   4. International Plumbing Code
   5. International Fire Code
   6. International Energy Code
   7. National Electric Code
   8. National Fire Protection Association Standards
   9. State Fire Marshal Regulations
   10. Local Fire Marshal Regulations
   11. ASHRAE Standards and Handbooks (Latest Editions)
   12. Local Health Department
   13. State Health Department
   14. Local Utility Companies
   15. Underwriters Laboratories
   16. Owner's Insurance Underwriter Standards
   17. Environmental Protection Agency

C. Give all necessary notices, obtain all permits, and pay all fees and other costs, including those for utility connections or extensions in connection with the work. File all necessary plans,

prepare all documents, and obtain all necessary approvals of all governmental departments having jurisdiction. Obtain all required certificates of inspection and deliver same to the Architect before request for acceptance and final payment for the work.

1.7 EQUIPMENT LIST

A. Provide a spreadsheet list of all equipment provided with the drawing tag number or designation, name, manufacturer, model number, serial number and full electrical characteristics.

B. This list shall be provided to the TAB agent, Commissioning Agent, BAS providers and to the Owner prior to beginning TAB work and as soon after all equipment is received on site.

1.8 EQUIPMENT START-UP AND INITIAL OPERATION

A. No equipment shall be operated, for testing or trial use, before full compliance with the equipment manufacturers' specifications and instructions for the lubrication, alignment, direction of rotation, balance, and other applicable considerations.

B. Particular care shall be taken to see that all equipment is completely assembled, properly lubricated, and all grease and oil cases and reservoirs have been filled to the correct level with the recommended lubricants.

C. It is the Contractor's responsibility to place each item of equipment, installed by him, in operating condition. This responsibility includes all auxiliaries, piping, wiring, etc., the start up of each unit, and a check of its performance.

1.9 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Refer to Section 017900 "Demonstration and Training"

B. Upon completion of all work and all tests, Contractor shall furnish the necessary skilled labor and helpers for operating the systems and equipment.

C. Contractor shall instruct the Owner's representative fully in the operation, adjustment, and maintenance of all equipment furnished.

1.10 SITE VISIT

A. Prior to preparing the bid, it is recommended that the Contractor and subcontractors shall visit the site and familiarize themselves with all existing conditions, make all necessary investigations as to locations of utilities, and all other matters which can affect the work.

B. No additional compensation will be made to the Contractor as a result of his failure to familiarize himself with the existing conditions under which the work must be performed.

1.11 DRAWINGS

A. The Contract Drawings are diagrammatic and indicate the general arrangement of systems and work included in the Contract. Any offsets, rises, or transitions not shown on the drawings and required to provide a complete system shall be provided at no additional contract cost. Do not scale the drawings. Consult the Architectural and Structural drawings and details for exact location of structure and equipment; where same are not definitely located, obtain this information from the Architect.

B. In the event of 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.

1.12 SINGULAR NUMBER

A. Where any device or part of equipment is herein referred to in the singular number (such as "valve"), such reference applies to as many such devices as are required to complete the installation as shown on the drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Refer to Section 013300 "Submittal Procedures" for additional information.

B. For each specified product, provide from single manufacturer. Do not mix and match various manufactures for a single product. If various manufacturers are required for a single product, indicate reason and locations where each will be installed.

C. All component parts of each items of equipment or device shall bear the manufacturers' name plate; giving name of manufacturer, description, size, type, serial or model number, electrical characteristics, etc., in order to facilitate the maintenance or replacement. The name plate of a subcontractor or distributor will not be acceptable. Where Underwriters' Laboratories standards apply, material and equipment shall be approved by them and shall bear the UL Label.

D. In specifying materials, three (3) general procedures are used. The three (3) classifications are as follows:
   1. GROUP 1: When a material or equipment is specified by brand name or other identifying information and three (3) or more brands are named it is considered that any one (1) of the brands so named will perform as desired, and the Contractor shall base his proposal on one (1) of the named brands. The first brand named or identified basis of design shall be used as a standard. The other brands named shall be equal to the specified brand in all respects. If one (1) of the other brands named is used it shall be the Contractor's responsibility to verify proper clearances and fit of the substituted equipment.
   2. GROUP 2: When the material or equipment is specified with the phrase "...or approved equal..." after a brand name and other identifying information, it is intended that the

brand name is used for the purpose of establishing a minimum acceptable standard of quality and performance and Contractor may base his bid proposal on any item which is in all respects equal to that specified and presents essentially the same appearance. It shall be the Contractor's responsibility to ensure proper fit and clearances of all substituted equipment.

3. GROUP 3: When material is specified as complying with the requirements of published "Standard Specification" of trade associations, American Society of Testing and Materials, government specifications, etc. the Contractor shall base his proposal on any item which can be shown to comply in all respects to the referred "Standard Specification".

E. It is distinctly understood: (1) that the Architect will use his own judgment in determining whether or not any materials, equipment or methods offered in substitution are equal to those specified; (2) that the decision of the Architect on all such questions of equality is final; and (3) that all substitutions will be made at no increase in cost to the Owner.

F. Upon receipt of written approval from Architect, Contractor may proceed with substitution providing Contractor assumes full responsibility for, and makes, at his own expense, any changes or adjustments in construction or connection with other work that may be required by the substitution of such materials, equipment or methods. In the event of any adverse decisions by the Architect no claim of any sort shall be made or allowed against the Owner.

G. All pipe and fittings shall be from a United States domestic manufacturer.

2.2 FIRE-RATED PENETRATIONS

A. Provide UL Listed fire penetration systems in openings in rated floors, walls, and other elements of construction. Provide UL listed fire penetration systems at all new and existing pipe penetrations of new and existing rated construction within the area of work. Coordinate work of this section with all other trades necessary for the proper installation of the fire rated penetration systems.

B. Submit shop drawings showing each condition requiring penetration seals in dictating proposed UL systems materials, anchorage, methods of installation, and actual adjacent construction. Submit a copy of UL illustration of each proposed system indicating manufacturer approved modifications. Submit copies of manufacturer's specifications, recommendations, inspection requirements, installation instructions, and maintenance data for each type of material required. Include letter indicating that each material complies with the requirements and is recommended for the applications shown.

C. All fire penetration systems shall reference ASTM E814/UL 1479 - Fire Test of Through - Penetration Fire Stops.

D. All systems shall be UL tested and listed in the UL Fire Resistance Directory.

E. Submit copies of written guarantee agreeing to repair or replace joint sealers which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability or appear to deteriorate in any other manner not clearly specified by submitted manufacturer's data as an inherent quality of the material for the

exposure indicated. The guarantee period shall be one (1) year from date of substantial completion.

F. 3M products have been specified as the penetration fire stop basis of design. Other manufacturer's systems are acceptable providing they meet the requirements set forth in this specification. The fire rated penetration systems shall be the products of one manufacturer to the maximum extent possible. The products of more than one manufacturer shall not be used as a combined seal.

G. Provide materials classified by UL to provide fire stopping equal to time rating, both "F" and "T" ratings, of construction being penetrated. Provide asbestos free materials that comply with applicable codes and have been tested under positive pressure in accordance with UL 1479 or ASTM E814. Systems shall be smoke and air tight.

H. Deliver material undamaged in manufacturer's clearly labeled, unopened containers identified with brand, type, grade, and UL label where applicable. Coordinate delivery with scheduled installation date to allow minimum storage time at site. Store material in clean, dry ventilated location. Protect from soiling, abuse, and moisture. Follow manufacturer's instruction.

I. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding. Proceed with installation only after penetrations of the substrate and supporting brackets have been installed.

J. Furnish adequate ventilation if using solvent. Furnish forced air ventilation during installation if required by manufacturer. Keep flammable materials away from sparks or flame. Provide masking and drop cloths to prevent contamination of adjacent surfaces by fire stopping resistance.

K. Clean surfaces to be in contact with penetration seal materials, of dirt, grease, oil, loose, materials, rust, or other substances that may affect proper fitting, adhesion of the required fire resistance.

L. Install penetration seal materials in accordance with printed instructions of the UL Fire Resistance Directory and in accordance with manufacturer's instructions. Seal holes or voids made by penetrations to ensure an effective smoke barrier. Where floor openings without penetrating items are more than four (4) inches in width and subject to traffic or loading, install fire stopping materials capable of supporting same loading as floor. Protect materials from damages on surfaces subject to traffic.

M. Clean up spills of liquid components. Neatly cut and trim materials as required. Remove equipment, materials, and debris, leaving area in undamaged, clean condition.

N. Examine penetration sealed areas to ensure proper installation before concealing or enclosing areas. Keep areas of work accessible until inspection by applicable code authorities. Perform under this section patching and repairing of fire stopping caused by cutting or penetration by local inspectors and other trades.

PART 3 - EXECUTION

3.1 WORKMANSHIP

A. The quality of workmanship required, for each trade, in the execution of work shall be the finest and highest obtainable in that trade working with the materials specified. Workmanship shall be satisfactory to the Architect and his decision as to acceptable quality is final.

B. Workmanship proven to be of poor quality or unsatisfactory in the commissioning phase of the project as deemed by the Architect shall be removed and replaced to the satisfaction of the Architect.

3.2 EQUIPMENT PERFORMANCE

A. All equipment, devices, controls, and hardware shall be proven to operate successfully throughout the guarantee period. Systems shall be proven during all-weather seasons and be demonstrated to affect the design conditions at times. System components or equipment items that fail to consistently deliver the design conditions shall be removed and replaced as directed by the Architect. The cost of required equipment replacements shall be borne by the Contractor.

B. All equipment shall be tested after installation and be proven to deliver the manufacturers quoted design capacity. When capacity is in question as deemed by the Architect, the Contractor shall perform a detailed and comprehensive field performance test to certify the equipment capacity. System effect or installed performance factors may not be applied to performance ratings unless they were previously included when the equipment was submitted for approval. Equipment that fails to deliver manufacturers quoted design capacity shall be removed and replaced at the Contractors expense.

C. Workmanship proven to be of poor quality or unsatisfactory in the commissioning phase of the project as deemed by the Architect shall be removed and replaced to the satisfaction of the Architect.

3.3 EQUIPMENT CONNECTIONS

A. All equipment shall be installed and connected in accordance with the best engineering practice and in accordance with manufacturer's instructions and recommendations. Auxiliary piping, piping specialties, water seals, valves, and electric connections recommended by the manufacturer, required by code or required for proper operation shall be provided.

3.4 CUTTING AND PATCHING

A. Cutting and patching associated with the work shall be performed in a neat and workmanlike manner. Existing surfaces, which are damaged by the Contractor, shall be repaired or provided with new materials. All patching shall be done with materials and methods similar to existing adjacent work, subject to approval of the Architect. Structural members shall not be cut or

penetrated. Holes cut through concrete and/or masonry to accommodate new work shall be cut by reciprocating or rotary, non-percussive methods.

B. Patching of areas disturbed by installation of new work shall match existing adjacent surfaces in material, texture, and color.

3.5 PROTECTION OF EXISTING WORK

A. When working in and around the building, extreme care shall be exercised with regard to protection of the structure and plumbing services. Repair or replace, to the satisfaction of the Architect, any existing work damaged in the performance of the new work.

3.6 SURVEYS AND MEASUREMENTS

A. Base all measurements (both horizontal and vertical) from established bench marks. All work shall agree with these established lines and levels. Verify all measurements at site and check correctness of same as related to the work. Verify locations of existing utilities and inverts of same prior to the start of any systems shown connecting to existing utilities.

B. Should the Contractor discover any discrepancy between actual measurements or conditions, and those indicated, which prevent following good practice or the intent of the drawings and specifications, he shall notify the Architect and shall not proceed with his work until he has received instruction from the Architect.

3.7 HANDLING AND STORAGE OF MATERIAL

A. Proper and suitable tools, equipment and appliances for the safe and convenient handling and placing of all materials and equipment shall be used. During loading, unloading, and placing, care shall be taken in handling the equipment and materials so that no equipment or materials are damaged.

B. All equipment delivered to the job site shall be stored on pedestals, above the ground and under roof or other approved covering. All enclosures for equipment shall be weatherproof. All motors, drives, switchgear, panels, etc. which are not totally enclosed, that are involved in the work, shall be stored in a heated, dry, water protected area with a minimum temperature of fifty degrees (50) Fahrenheit. All valves shall be stored under roof on wood pedestals, above ground. All insulation shall be stored under roof or in trailers, adequately protected from the weather. The Contractor shall follow all written instructions and recommendations of the manufacturer and all requirements of the Architect in oiling, protection and maintenance of equipment during storage. It shall be the Contractor's complete responsibility for the storage and care of the equipment and materials.

C. If any equipment and/or materials are found to be in poor condition at the time of installation the Architect may, at his discretion, order the Contractor to furnish and install new equipment and/or material at no cost to the Owner.

3.8 COOPERATION WITH OTHER TRADES

A. Plumbing trades shall give full cooperation to other trades and shall furnish in writing, with copies to Architect any information necessary to permit the work of all trades to be installed satisfactorily and with least possible interference or delay. Exact location of all plumbing and equipment, devices, etc. in finished spaces shall be coordinated with Architectural reflected ceiling plans, elevations and details.

3.9 CLEANING AND PATCHING

A. Thoroughly clean all exposed surfaces of equipment and material and leave in a neat, clean condition.

B. Restore and touch-up factory finishes which have been damaged during construction.

3.10 ACCESSIBILITY

A. Equipment shall be installed per manufacturer's recommended clearance guidelines with sufficient space for maintenance personnel service, operate, and maintain equipment.

B. Locate all above ceiling equipment which must be serviced, operated, or maintained, in fully accessible positions to eliminate the need for access panels and doors. Equipment shall include, but not be limited to, valves, clean-outs, motors, controllers, dampers, drain points, etc.

C. Where overhead equipment cannot be located above spaces with either no ceilings or removable acoustical ceiling tiles, contractor shall provide, as part of the contract and no expense to the Owner, fourteen (14) gauge painted steel access doors where required and/or where directed (color shall match ceiling).
   1. Access doors shall be Milcor or approved equal to suit material in which installed.
   2. Access doors installed in fire rated walls or shafts shall be labeled and shall match rating of the construction.
   3. Doors shall be of sufficient size to allow access to all components; minimum size shall be eighteen (18) inches by eighteen (18) inches.
   4. Doors in Toilet Rooms and Janitor's Closets shall be Type 304 stainless steel.
   5. All doors shall have cylinder locks operable from same key.
   6. Submit shop drawings for approval. Locations shall be coordinated with the Architect and indicated on the composite installation and coordination drawings

D. Equipment deemed inaccessible by the Architect shall be reworked by the Contractor at no expense to the Owner.

3.11 EQUIPMENT BASES AND SUPPORTS

A. Concrete bases, curbs, and supports will be furnished and installed under this Division and shall be in accordance with Division 3.

B. The Subcontractors shall furnish, to the General Contractor, all required foundation sizes, bolts, washers, sleeves, plates and templates for equipment.

C. The size of the foundation bolts shall be as recommended by the manufacturer.

D. All equipment shall be set on the foundations, shimmed level with steel shims, and grouted up under base for uniform bearing by the Subcontractor.

E. Under this Section, provide all equipment supports; consisting of inertia pads, platforms, gratings, structural members and related materials required for the mechanical and electrical work.

F. The type and size of the supporting channels and supplementary steel shall be determined by the Subcontractor and shall be of sufficient strength and size to allow only a minimum deflection in conformance with the manufacturer's requirements for loading.

3.12 DEMOLITION

A. All existing piping, conduit, equipment and materials not required for re-use or re-installation shall be removed. Any existing materials and equipment which are removed and are desired by the Owner or are indicated to remain the property of the Owner, shall be delivered to him on the premises by the Contractor where directed by the Architect. All other materials and equipment which are removed shall become the property of the Contractor and shall be removed by him from the premises.

B. Existing piping that remains concealed, buried, or otherwise contained in the remaining slabs and walls shall be capped, plugged, or otherwise sealed. All pipes shall be cut so that their capped or plugged ends will be below the finished floors or behind finished surfaces.

C. Existing wiring, where possible, shall be removed or pulled through conduits. Wiring remaining shall be cut back behind the termination of conduits so that conduits can be adequately capped, plugged, or sealed.

3.13 CONNECTIONS AND ALTERATIONS TO EXISTING WORK

A. When existing plumbing work is removed, all pipes, valves and materials shall be removed to a point below the finished floors or behind finished walls and capped. Such points shall be far enough behind finished surfaces to allow for the installation of the normal thickness of finished material.

B. When the work specified hereinafter connects to existing equipment or piping, the Contractor shall perform all necessary alterations, cuttings, or fitting of existing work as may be necessary or required to make satisfactory connections between the new and existing work and to leave the completed work in a finished and workmanlike condition, to the entire satisfaction of the Architect.

C. When the work specified hereinafter or under other divisions of the contract necessitates relocation of existing equipment, piping, or ductwork, the Contractor shall perform all work and

make all necessary changes to existing work as may be required to leave the completed work in a finished and workmanlike condition, to the satisfaction of the Architect. All work resulting in an extra to the contract shall be approved by the Owner and Architect before proceeding.

D. All cutting and patching necessary for the installation of the plumbing work shall be done under this Division. Any damage done to the work already in place shall be repaired at the Contractor's expense. Patching shall be uniform in appearance and shall match the surrounding surface.

E. When the work specified hereinafter connects to existing piping, to avoid possible cross-connection of supply and return lines, the Contractor shall field verify the configuration of supply and return lines, using an appropriate temperature sensing or pressure device, before making final connections. Any discrepancy between construction documents and field verification should be promptly reported to the Architect before completing piping installation, so proper piping configuration can be verified.

3.14 INTERRUPTION OF EXISTING UTILITIES

A. Notify the Owner in writing at least ten (10) calendar days in advance of any required shutdown of water, sewage, gas, electrical service or other utility. Upon written receipt of approval from Owner, shutdowns shall be performed between the hours of six (6) p.m. and six (6) a.m. including clean-up or as directed otherwise and shall be accomplished at no additional cost.

B. At the end of each interruption, all services shall be restored so that normal use of the building can continue.

END OF SECTION 220500

SECTION 220800 - COMMISSIONING OF SERVICE WATER HEATING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes commissioning process requirements for Service Water Heating Systems, assemblies, and equipment.

B. Related Sections: Section 019113 "General Commissioning Requirements" for general commissioning process requirements.

1.3 DEFINITIONS

A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

B. CxA: Commissioning Authority.

C. Service Water Heating Systems: Service Water Heating Equipment, Pressure Regulating Devices, Mixing Valves, Piping, Insulation, Pumps, Variable Speed Drives, Controls, Interlocks, Interfaces, Safeties, Accessories and Appurtenances.

D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates of readiness.

B. Pre-Functional Test Checklists and Equipment Start up Reports

1.5 CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests at the direction of the CxA.

B. Attend construction phase controls coordination meetings.

C. Attend testing, adjusting, and balancing review and coordination meetings.

D. Participate in the commissioning of Service Water Heating Systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.

E. Provide information requested by the CxA for final commissioning documentation.

F. Provide measuring instruments and logging devices, calibrated within one year of date of test unless specifications or industry standards require more stringent calibration periods, to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.6 CxA'S RESPONSIBILITIES

A. Provide Project-specific construction checklists and commissioning process test procedures for actual Service Water Heating Systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

B. Direct commissioning testing.

C. Verify testing, adjusting, and balancing of Work are complete.

D. Organize Contractor provided test data, inspection reports, and certificates in Systems Manual.

1.7 COMMISSIONING DOCUMENTATION

A. Provide the following information to the CxA for inclusion in the commissioning plan:
1. Plan for delivery and review of submittals, operation and maintenance manuals, and other documents and reports.
2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for Service Water Heating Systems, assemblies, equipment, and components to be verified and tested.
4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
5. Certificate of readiness certifying that Service Water Heating Systems, subsystems, equipment, and associated controls are ready for testing.
6. Test and inspection reports and certificates.
7. Corrective action documents.
8. Verification of testing, adjusting, and balancing reports.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Provide a fully executed Certificate of Readiness signed by Contractor, Subcontractors, TAB Agent and BAS provider certifying that Service Water Heating Systems, instrumentation and control systems have been completed and calibrated, pre-tested and inspected and that they are operating according to the Contract Documents, and that pretest set points have been recorded. Provide completed Certificate of Readiness to CxA no less than 7 days prior to the scheduled beginning of on-site CxA verification testing.

B. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

C. Inspect and verify the position of each device and interlock identified on checklists.

D. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 TESTING AND BALANCING VERIFICATION

A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.

B. Notify the CxA at least 30 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.

C. Provide technicians, instrumentation, and tools to verify testing and balancing of Service Water Systems at the direction of the CxA.

D. The CxA will notify Service Water Heating testing and balancing Subcontractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
1. The testing and balancing Subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.
2. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report.
3. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of Service Water Systems testing shall include entire Service Water Heating Systems installation, from central equipment for heat generation through distribution systems to each water outlet and device.

C. Testing of systems and equipment shall include measuring capacities and effectiveness of operational and control functions, in addition to, or in conjunction with any statutory and regulatory testing required by Authorities Having Jurisdiction over the project and testing required in other Sections of this Project Manual.

D. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

E. The CxA along with the Service Water Heating Systems Subcontractor shall prepare detailed testing plans, procedures, and checklists for Service Water Heating Systems, subsystems, and equipment.

F. Tests will be performed using design conditions whenever possible.

G. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

H. The CxA may direct that set points be altered when simulating conditions is not practical.

I. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

J. If tests cannot be completed because of a deficiency outside the scope of the Service Water Heating Systems system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

K. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

END OF SECTION 220800

SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, induction motors for use on alternating-current power systems and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

1.4 SUBMITTALS

A. Shop Drawings and Product Data: Shop drawings and product data for motors shall be provided with the submittal package for the piece of equipment that it serves. In accordance with Division 01, Section "Submittals" provide the following:
1. Product catalog data: nameplate data and ratings; materials of construction; mounting arrangement, size and location of motor terminal box and conduit entry, grounding lugs and coatings.

B. Warranties
1. In addition to the warranty requirements of the General Conditions, warranties for each motor shall be covered in the warranty for the entire mechanical assembly (fan & motor, pump and motor, etc).

C. Manufacturer Seismic Qualification Certification: Submit certification that motors, accessories, and components will withstand seismic forces defined in Division 23, Section "Mechanical Vibration, Sound and Seismic Controls. Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Operation and Maintenance Data: For factory-installed motors to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain factory-installed motors through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70, "National Electrical Code."

D. NRTL Listing: Motors shall be NRTL-listed.
1. Term "Listed": As defined in "National Electrical Code," Article 100.
2. Listing Agency Qualifications: "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.

E. Comply with NEMA MG 1, "Motors and Generators."

F. Comply with UL 1004, "Motors, Electric."

G. Provide factory test reports in accordance with Part 2 of this Section.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Whenever possible, motor and driven equipment shall be shipped complete as an entire assembly.

B. Inspect equipment immediately upon arrival and any irregularities or damage shall be reported to the Manufacturer/Supplier immediately.

C. Store in accordance with manufacturer's recommendations.

1.7 IDENTIFICATION

A. Nameplates: All motors shall have a stainless steel nameplate attached with stainless steel fasteners on the motor. The nameplate shall be stamped with nameplate markings listed in NEMA MG 1 20.60, plus the following:
   1. Manufacturer
   2. Model Number
   3. Serial Number
   4. Nominal efficiency
   5. Minimum efficiency
   6. Temperature Rise
   7. Bearing manufacturer's name and catalog number

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Motor requirements apply to factory-installed motors except as follows:
   1. Different ratings, performance, or characteristics for motor are specified in another Section.
   2. Motorized-equipment manufacturer requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.

C. Contractor assumes responsibility for the correct direction of rotation required by the equipment drives. In the event of damage due to reverse rotation, the equipment shall be repaired or replaced at no charge to the Owner.

D. Motor Bearings: Motor bearings shall be specifically designed for the drive application, and shall be approved by the Engineer. Bearings shall have a minimum bearing life of B-10 or L-10 as defined by the AFBMA. Bearings shall be designed to carry the total hydraulic and static thrust developed by the driven load. Bearings shall be grease or oil lubricated. Oil lubricated motors shall be fitted with gravity-feed oil reservoirs. Grease lubricated bearings shall be regreasable (not sealed) and shall be supplied with grease fittings and drain plugs. Medium voltage and variable frequency controlled motor bearings shall be electrically isolated from the shaft on at least one end to prevent transmission of electric current. Current drain brushes shall be fitted where it is necessary to divert the flow of electrical current from bearings. Bearings, housing and brackets shall be constructed to permit access, removal and replacement of the bearings without disassembly of the motor.

E. Rotor: The rotor shall be dynamically and statically balanced. Assembled motor shall be tested at the factory in accordance with latest applicable NEMA MG 1and IEEE 112 methods of testing, and balanced at no more than 0.001 inches total peak-to-peak deflection on the bearing housing and the shaft. Overall vibration readings, including all vibration frequencies, shall be taken and recorded at no load and design speed.

F. Terminal Box: Motors shall have a watertight cable terminal box. Terminal box shall be oversized, diagonally split, and rotatable in 90o increments to allow conduit and cable entry from top, bottom and sides.

G. Motor Leads: Motor leads shall be a minimum of 6 inches in length. All motor leads shall be extended from the conduit box. Motors rated over 200 HP or over 600V shall have insulated tin plated copper busbar terminals with bolt holes for compression wire lugs.

H. Drains and Breathers: Provide drain(s) in the bottom of the motor at the lowest point(s). Enclosed motors shall be fitted with breathers.

I. Screens: Provide stainless steel screens at motor ventilation openings.

J. Motor Shaft: The motor shaft shall be ASTM A322 GR140 (AISI 4140) steel and shall be sized to accommodate the required power and torque. Provide shaft end with keyway for connection to coupling with the pump shaft. Coordinate shaft design requirements with driven load.

K. Stainless Steel Hardware: Provide corrosion resistant hardware for motor components including grease fittings, plugs, nuts, bolts, washers and screws.

L. Motor Casing and Coating: Housings shall be degreased, primed and painted both inside and outside with a rust inhibitive primer and corrosion resistant polyester paint. Painting shall be performed prior to installing the motor stator windings. The primer and paint materials selected shall be suitable for the environment encountered, both inside and outside of the casing.

M. Motors connected to Variable Frequency Drives shall be "inverter duty" with additional magnet wire insulation to achieve a minimum motor impulse voltage rating equal to the VFD manufacturer's recommendations for the motor, cable size, and cable length actually installed.

N. Shaft Grounding Ring: Each motor shaft shall be provided with a Shaft Grounding Ring (SGR) that will provide a reliable low resistance path from the motor shaft to the motor frame to prevent the buildup of destructive high frequency shaft currents that are created by the Pulse Width Modulation of the Variable Frequency Drive units. The SGR shall encircle the shaft and shall be designed to promote efficient discharge of the high frequency shaft currents to the motor frame. The motor frame shall be inherently grounded by design.

O. Power Factor Correction Capacitors: Provide motor power factor correction capacitors for all motors rated 600V or less (except variable frequency controlled motors) with less than 90% uncorrected power factor. Motor power factor correction capacitors shall be sized as recommended by the motor manufacturer to correct the motor power factor to over 90%. Motor power factor correction capacitor sizes shall not be larger than the maximum size recommended by the motor manufacturer. Enclosure type shall be NEMA 12. Capacitors shall be dry film type with fuses and discharge resistors.

P. Composite Factor: Each motor, 1 HP or larger, or motor driven equipment, 1 HP or larger shall have a composite power factor (PF) rating of ninety (90) percent to 100 percent when the driven equipment is operating at the design duty defined on the drawings. Power factor correction devices shall be provided to meet the stated criteria.

Q. Devices such as capacitors, or equipment such as solid state power factor controllers, shall be provided as part of the motor or item of motor driven equipment when required for power factor correction. Devices shall be completely mounted and wired to the motor terminal except as follows:
   1. For a motor or motor driven equipment requiring other than across-the-line starting, power factor (PF) correcting capacitors, or other equipment, shall be connected to motor terminals via a contactor (controller) with a 120 volt alternating current (VAC) coil. The 120 volt alternating current (VAC) coil shall be energized via an auxiliary contact on the contactor (controller) used to establish the "run" operating mode for the motor driven equipment.
   2. For two (2) speed motors, power factor (PF) shall be corrected at each speed via separate groups of capacitors or other equipment for each speed. Each group of PF correcting components shall be connected to motor terminals via a separate contactor (controller) with a 120 volt alternating current (VAC) coil. Each 120 volt alternating current (VAC) coil shall be energized via an auxiliary contact on the contactor or controller used to establish "run" operations at each speed.

R. Locked rotor kVA shall not exceed NEMA Code Letter F for motors over 10 horsepower.

S. Motors shall have the following enclosure types in accordance with NEMA MG 1:
   1. For clean dry indoor areas: open drip proof (ODP) fully-guarded
   2. For outdoor locations: totally-enclosed fan-cooled for small and medium machines, weather protected type II for large machines
   3. Explosion-proof machines shall be provided for hazardous areas classified in accordance with NFPA 70 (National Electrical Code). Explosion proof motors shall be NRTL-listed for the hazardous area classification.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

C. Motors ½ HP and Larger: Three phase, unless otherwise indicated.

D. Motors Smaller Than ½ HP: Single phase.

E. Frequency Rating: 60 Hz.

F. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Stator: Copper windings, unless otherwise indicated.
   1. Multispeed Motors: Separate winding for each speed.

E. Rotor: Random-wound, squirrel cage.

F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: One temperature rise one class below the insulation rating class; for example, Class B temperature rise with Class F insulation.

H. Insulation: Class F, unless otherwise indicated.

I. Code Letter Designation:
   1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
   2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.

J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

   1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width-modulated inverters.
   2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
   3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
   4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
   1. Permanent-split capacitor.
   2. Split phase.

3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION

3.1 COMMISSIONING

A. Check operating motors for unusual conditions during normal operation. Coordinate with the commissioning of the equipment for which the motor is a part.

B. Report unusual conditions.

C. Correct deficiencies.

END OF SECTION 220513

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.

B. Related Requirements:
1. Division 07 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, Inc
2. CALPICO, Inc
3. GPT; an EnPro Industries company

B. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.

C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, anticorrosion coated or galvanized, with plain ends and integral welded waterstop collar.

D. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, Inc
2. CALPICO, Inc
3. GPT; an EnPro Industries company
4. Metraflex Company (The)
5. Proco Products, Inc

B. Description:
1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
2. Designed to form a hydrostatic seal of 20 psig minimum.
3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
4. Pressure Plates: Carbon steel.
5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B 633 of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, Inc
2. CALPICO, Inc
3. GPT; an EnPro Industries company
4. Metraflex Company (The)
5. Proco Products, Inc

B. Description:
1. Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.
2. Plastic or rubber waterstop collar with center opening to match piping OD.

2.4 GROUT

A. Description: Nonshrink, 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.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. Fasten sleeves securely in floors and walls so that they will not become displaced when concrete is poured or when other construction is built around them. Take precautions to prevent concrete, plaster or other materials from being forced into space between pipe and sleeve during construction

C. 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.

D. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
   2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

E. 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 minimum 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

F. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and

sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 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. Use grout to seal the space around outside of sleeve-seal fittings.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.

B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

   1. Exterior Concrete Walls above Grade:
      a. Piping Smaller Than NPS 6: Steel pipe sleeves or sleeve-seal fittings.
      b. Piping NPS 6 and Larger: Steel pipe sleeves or sleeve-seal fittings.

   2. Exterior Concrete Walls below Grade:
      a. Piping Smaller Than NPS 6: Steel pipe sleeves with sleeve-seal system, or sleeve-seal fittings.
         1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
      b. Piping NPS 6 and Larger: Steel pipe sleeves with sleeve-seal system, or sleeve-seal fittings.
         1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

   3. Concrete Slabs-on-Grade:
      a. Piping Smaller Than NPS 6: Steel pipe sleeves with sleeve-seal system, or sleeve-seal fittings.
         1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 and Larger: Steel pipe sleeves with sleeve-seal system, or sleeve-seal fittings.
   1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:
   a. Piping Smaller Than NPS 6: Steel pipe sleeves or sleeve-seal fittings.
   b. Piping NPS 6 and Larger: Steel pipe sleeves.

5. Interior Partitions:
   a. Piping Smaller Than NPS 6: Steel pipe sleeves.
   b. Piping NPS 6 and Larger: Galvanized-steel sheet sleeves.

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Escutcheons.
   2. Floor plates.

1.3 DEFINITIONS

A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed and salvaged, or removed and reinstalled.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. BrassCraft Manufacturing Co.; a Masco company
   2. Dearborn Brass
   3. Keeney Manufacturing Company (The)
   4. Mid-America Fittings, Inc.
   5. ProFlo; a Ferguson Enterprises, Inc. brand

2.2 ESCUTCHEONS

A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.

C. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

D. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel or brass with polished, chrome-plated finish and spring-clip fasteners.

E. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.

F. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

2.3 FLOOR PLATES

A. Split Floor Plates: Steel with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for exposed piping penetrations of finished walls, ceilings, and floors.

B. Install escutcheons on bare piping to be compatible with pipe material:
1. Copper Piping: Brass
2. Ferrous Piping: Steel.
3. Plastic Piping: Steel.
4. Stainless Steel Piping: Stainless Steel.

C. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
1. Escutcheons for New Piping and Relocated Existing Piping:
   a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
   b. Chrome-Plated Piping: One-piece or split-plate, with concealed hinge with polished, chrome-plated finish.
   c. Insulated Piping: One-piece or split-plate with concealed hinge with polished, chrome-plated finish.
   d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece or split-plate with concealed hinge with polished, chrome-plated finish.
   e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-plate with concealed hinge with polished, chrome-plated finish.
   f. Bare Piping in Unfinished Service Spaces: One-piece or split-plate with concealed hinge with polished, chrome-plated finish.
   g. Bare Piping in Equipment Rooms: One-piece or split-plate with concealed hinge with polished, chrome-plated finish.
2. Escutcheons for Existing Piping to Remain:
   a. Chrome-Plated Piping: Split-plate with concealed hinge with polished, chrome-plated finish.
   b. Insulated Piping: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.

c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate with concealed hinge with polished, chrome-plated finish.
d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate with concealed hinge with polished, chrome-plated finish.
e. Bare Piping in Unfinished Service Spaces: Split-plate with concealed hinge with polished, chrome-plated finish.
f. Bare Piping in Equipment Rooms: Split-plate with concealed hinge with polished, chrome-plated finish.

D. Install floor plates for exposed piping penetrations of floors in finished areas with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
1. New Piping and Relocated Existing Piping: One-piece, floor plate.
2. Existing Piping: Split floor plate.

3.2 FIELD QUALITY CONTROL

A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 220518

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Bimetallic-actuated thermometers.
2. Digital light-activated thermometers.
3. Thermowells.
4. Dial-type pressure gages.
5. Gage attachments.
6. Test plugs.
7. Sight flow indicators.

B. Related Requirements:
1. Section 221119 "Domestic Water Piping Specialties" for domestic water flow meters.
2. Section 221513 "General-Service Compressed-Air Piping" for compressed air gages.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Weiss SF3VBM or comparable product by one of the following:
1. Ashcroft, Inc.
2. Trerice, H. O. Co.
3. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
4. Weiss Instruments, Inc.

5. Weksler Glass Thermometer Corp.

B. Standard: ASME B40.200.

C. Case: Liquid-filled and hermetically sealed type; 304 stainless steel with 3-inch nominal diameter.

D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.

E. Connector Type(s): Union joint, adjustable, bottom, with unified-inch screw threads.

F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.

G. Stem: 0.25 or 0.375 inch in diameter; welded stainless steel.

H. Window: Plain glass.

I. Ring: Stainless steel.

J. Element: Bimetal coil.

K. Pointer: Dark-colored metal.

L. Accuracy: Plus or minus 1 percent of scale range.

2.2 DIGITAL LIGHT-ACTIVATED THERMOMETERS

A. Direct-Mounted, Light-Activated Thermometers:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Weiss DVU35 or comparable product by one of the following:
   a. Trerice, H. O. Co.
   b. Weiss Instruments, Inc.
   c. Weksler Glass Thermometer Corp.
2. Case: Hi-impact ABS.
3. Scale(s): Deg F, -50°F to 300°F.
4. Case Form: Adjustable angle.
5. Display: Digital, 1/2" digits.
6. Accuracy: 1% of reading or 1°F, whichever is greater
7. Resolution: 1/10° between -19.9°F to 199.9°F
8. Recalibration: Through case potentiometer adjustment
9. Lux rating: 10 Lux (one foot-candle)
10. Update: 10 seconds
11. Ambient Operating Temperature: -30°F to 140°F
12. Ambient Temperature Error: Zero
13. Ambient Operating Humidity: 100%
14. Sensor: Glass passivated thermistor – NTC.
15. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
16. Stem: Aluminum and of length to suit installation.
    a. Design for Thermowell Installation: Bare stem.

2.3 THERMOWELLS

A. Thermowells:
1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: Copper-nickel.
4. Material for Use with Steel Piping: Corrosion-resistant steel.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.4 DIAL-TYPE PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Ashcroft Type 1010 or comparable product by one of the following:
   a. Ashcroft, Inc.
   b. Trerice, H. O. Co.
   c. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
   d. Weiss Instruments, Inc.
2. Standard: ASME B40.100.
3. Accuracy: Grade 1A, plus or minus 1 percent of middle half of scale range.
4. Case: Open-front, pressure relief type; black epoxy painted aluminum; 4-1/2-inch nominal diameter.
5. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
6. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
7. Movement: Mechanical, with link to pressure element and connection to pointer.
8. Dial: Nonreflective aluminum, white background with permanently etched black scale markings graduated in psi.
9. Pointer: Dark-colored metal, micrometer adjustable.
10. Window: Glass.
11. Ring: Threaded reinforced black metal.
12. Connection Location: Lower or back.
13. Mounting: Stem.

2.5 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston or porous-metal-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass ball, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.6 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ashcroft, Inc.
   2. Trerice, H. O. Co.
   3. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
   4. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.7 SIGHT FLOW INDICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ARCHON Industries, Inc
   2. Dwyer Instruments, Inc
   3. Emerson Process Management; Rosemount Division
   4. Ernst Flow Industries
   5. KOBOLD Instruments, Inc.
   6. Pentair Valves & Controls; Penberthy Brand

B. Description: Piping inline-installation device for visual verification of flow.

C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.

D. Minimum Pressure Rating: 125 psig.

E. Minimum Temperature Rating: 200 deg F.

F. End Connections for NPS 2 and Smaller: Threaded.

G. End Connections for NPS 2-1/2 and Larger: Flanged.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

G. Install valve and snubber in piping for each pressure gage for fluids.

H. Install test plugs in piping tees.

I. Install thermometers in the following locations:
   1. Building water service entrance into building.
   2. Inlet and outlet of each water heater.
   3. Inlets and outlets of each domestic water heat exchanger.
   4. Inlet and outlet of each domestic hot-water storage tank.

J. Install pressure gages in the following locations:
   1. Building water service entrance into building.
   2. Inlet and outlet of each pressure-reducing valve.
   3. Suction and discharge of each domestic water pump.

K. Install isolation valves on both sides of flowmeters to allow servicing.

L. Unless otherwise indicated by the manufacturer, provide three straight pipe diameters upstream and two straight pipe diameters downstream of flowmeters.

M. Install wells in plumbing piping for automatic temperature control sensors. Exact locations and number of wells required shall be determined through coordination with the work required under Division 23, Section "Building Automation and Temperature Control System."

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F.

B. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F.

3.5 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Water Service Piping: 0 to 100 psi.

B. Scale Range for Domestic Water Piping: 0 to 100 psi.

END OF SECTION 220519

SECTION 220523 - VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Ball valves.
   2. Butterfly valves.
   3. Check valves.
   4. Gate valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene-diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.
   1. Certification that products comply with NSF 61 Annex G and NSF 372 for products that come in contact with potable water.

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, and soldered ends.
   3. Set ball valves open to minimize exposure of functional surfaces.
   4. Set butterfly valves closed or slightly open.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles, stems or handwheels as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

C. ASME Compliance:
   1. ASME B1.20.1 for threads for threaded end valves.
   2. ASME B16.1 for flanges on iron valves.
   3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   4. ASME B16.18 for solder-joint connections.
   5. ASME B31.9 for building services piping valves.

D. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.

E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

F. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

G. Valve Sizes: Same as upstream piping unless otherwise indicated.

H. Valve Bypass and Drain Connections: MSS SP-45.

I. Ball Valve Actuator Types:
   1. Gear Actuator: For quarter-turn valves NPS 4 and larger.

J. Valves in Insulated Piping:
   1. Include 2-inch stem extensions with protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
   2. For valves used for throttling or balancing, include memory stops that are fully adjustable after insulation is applied.

2.2 BALL VALVES

A. Brass Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. Crane; Crane Energy Flow Solutions
      c. Hammond Valve
      d. Milwaukee Valve Company
      e. NIBCO INC.
      f. WATTS
   2. Description:
      a. Standard: MSS SP-110.
      b. CWP Rating: 600 psig.
      c. Body Design: Two piece.
      d. Body Material: Lead free brass.
      e. Ends: Threaded or soldered.
      f. Seats: PTFE.
      g. Stem: Stainless steel.
      h. Ball: Stainless steel, vented.
      i. Port: Full.

2.3 CHECK VALVES

A. Bronze Swing Check Valves with Bronze Disc, Class 125:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. Crane; a Crane brand
      c. Hammond Valve
      d. Jenkins Valves; a Crane brand
      e. Milwaukee Valve Company
      f. NIBCO INC.
      g. Stockham; a Crane brand
      h. WATTS
   2. Description:
   3. Standard: MSS SP-80, Type 3.
   4. CWP Rating: 200 psig.
   5. Body Design: Horizontal flow.
   6. Body Material: ASTM B62, bronze.
   7. Ends: Threaded or soldered. See valve schedule articles.
   8. Disc: Bronze.

B. Iron, Globe, Center-Guided Check Valves with Metal Seat, Class 150:
   1. Description:
      a. Standard: MSS SP-125.
      b. NPS 2-1/2 to NPS 12, CWP Rating: 300 psig.
      c. NPS 14 to NPS 24, CWP Rating: 250 psig.
      d. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.

e. Style: Globe, spring loaded.
f. Ends: Flanged.
g. Seat: Bronze.

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. Valves shall be provided where indicated on the drawings and as herein specified.

B. Install shut-off valves in piping where shown and where listed below:
1. To isolate all items of equipment.
2. To isolate motorized flow control valves.
3. To isolate branch lines and riser at mains.

C. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

D. Locate valves for easy access and provide separate support where necessary.

E. Install valves in horizontal piping with stem at or above center of pipe.

F. Install valves in position to allow for handwheel operation, full stem movement and stuffing maintenance.

G. Install chainwheels on operators for butterfly valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

H. 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.

I. Install valve tags.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. Use gate valves for shutoff service only.

B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

C. Select valves with the following end connections:
1. NPS 2 and Smaller: Threaded or soldered.
2. NPS 2-1/2 to NPS 4: Flanged or threaded.

3.5 DOMESTIC WATER VALVE SCHEDULE

A. Ball Valves:
1. Pipe NPS 3 and Smaller: Brass ball valves, two-piece with full port and stainless-steel trim.

B. Check Valves:
1. Pipe NPS 3 and Smaller: Bronze swing check valves with bronze disc, Class 125, with soldered end connections.

3.6 SANITARY, WASTE AND STORM DRAINAGE VALVE SCHEDULE

A. Sump Pump Check Valves:
1. Iron, globe, center-guided, metal-seat check valves.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal hanger-shield inserts.
4. Fastener systems.
5. Pipe stands.
6. Pipe-positioning systems.
7. Equipment supports.

B. Related Requirements:
1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 220516 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
3. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. It shall be the responsibility of the Contractor to provide an adequate pipe hanger and support system for all pipe systems and equipment in accordance with recognized engineering practices, using standard, commercially accepted pipe hangers and suspension equipment.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
   1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
   2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
   3. Design seismic-restraint hangers and supports for piping and equipment.

2.2 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, hot-dip galvanized, or electro-galvanized.
   3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
   4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
   5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Stainless-Steel Pipe Hangers and Supports:
   1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
   3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe and Tube 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.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 THERMAL HANGER-SHIELD INSERTS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Pipe Shields Inc or comparable product by one of the following:
   1. Carpenter & Paterson, Inc
   2. Clement Support Services
   3. ERICO International Corporation
   4. Insulation Components, Inc.
   5. National Pipe Hanger Corporation
   6. Pipe Shields Inc.
   7. Piping Technology & Products, Inc
   8. Rilco Manufacturing Co., 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 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 shall cover entire circumference of pipe. Shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Hilti, Inc.
      b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
      c. MKT Fastening, LLC
      d. Simpson Strong-Tie Co., Inc.

B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. B-line, an Eaton business
      b. Hilti, Inc.
      c. ITW Ramset/Red Head; Illinois Tool Works, Inc.
      d. MKT Fastening, LLC

2. Indoor Applications: Zinc-coated or stainless steel.
3. Outdoor Applications: Stainless steel.

C. Per IBC Section 1912 and ACI 318 Appendix D, all concrete anchors within the scope of ACI 318 require approved anchors for crack concrete. Attachment devices shall have certified load test data from an independent test laboratory and shall be capable of carrying a minimum of five times the design load. The concrete anchors for the following supported items need to meet the crack concrete requirements:
1. Any suspended pipe, larger than 2", regardless of material.
2. All components with an Ip 1.5.
3. All components required to function after a seismic event.
4. Anywhere required by ASCE 7.

2.6 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand:
1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
3. Hardware: Galvanized steel or polycarbonate.
4. Accessories: Protection pads.

C. Low-Profile, Single-Base, Single-Pipe Stand:
1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
3. Vertical Members: Two galvanized-steel, continuous-thread, 1/2-inch rods.
4. Horizontal Member: Adjustable horizontal, galvanized-steel pipe support channels.
5. Pipe Supports: Roller or strut clamps.
6. Hardware: Galvanized steel.
7. Accessories: Protection pads.
8. Height: 12 inches above roof, unless otherwise noted.

D. High-Profile, Single-Base, Single-Pipe Stand:

1. Description: Single base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Single vulcanized rubber or molded polypropylene.
3. Vertical Members: Two galvanized-steel, continuous-thread, 1/2-inch rods.
4. Horizontal Member: One adjustable-height, galvanized-steel, pipe-support slotted channel or plate.
5. Pipe Supports: Roller, clevis hanger or swivel hanger.
6. Hardware: Galvanized steel.
7. Accessories: Protection pads, 1/2-inch, continuous-thread, galvanized-steel rod.
8. Height: 36 inches above roof, unless otherwise noted.

E. High-Profile, Multiple-Pipe Stand:
1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: Two or more; vulcanized rubber or molded polypropylene.
3. Vertical Members: Two or more, galvanized-steel channels.
4. Horizontal Members: One or more, adjustable-height, galvanized-steel pipe support.
5. Pipe Supports: Roller, strut clamps, clevis hanger or swivel hanger.
6. Hardware: Galvanized steel.
7. Accessories: Protection pads, 1/2-inch, continuous-thread rod.
8. Height: 36 inches above roof, unless otherwise noted.

F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 PIPE-POSITIONING SYSTEMS

A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.8 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.9 MATERIALS

A. Aluminum: ASTM B 221.

B. Carbon Steel: ASTM A 1011/A 1011M.

C. Structural Steel: ASTM A 36/A 36M carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A 240/A 240M.

E. Grout: ASTM C 1107/C 1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported operating components with a design safety factor of not less than five.

3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
   3. The use of cable ties, zip ties and/or tie wraps for attaching piping to metal trapeze pip-hanger is prohibited. Provide appropriate strut clamps, brackets and/or similar attachments to properly secure piping to trapeze pipe-hangers.

C. Thermal Hanger-Shield Installation: Install in pipe hanger for insulated piping.

D. Fastener System Installation:
   1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
   2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

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 Section 077200 "Roof Accessories" for curbs.

F. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.

L. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

N. Insulated Piping:
1. Attach clamps and spacers to piping.
    a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
4. Shield Dimensions for Pipe: Not less than the following:
    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.
    c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 2-1/2 and Larger: Include thermal hanger shield inserts of length at least as long as protective shield. Insert thickness shall be the same thickness as piping insulation. Fill interior voids with insulation that matches adjoining insulation and seal as appropriate.

O. In no case shall wire or perforated strap be used for pipe or conduit support.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 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 maximum 1-inch.

3.6 PAINTING

A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A 780/A 780M.

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-58 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications with field-applied finish.

D. Use hangers and supports with electro-galvanized coatings for piping and equipment that will not have field-applied finish.

E. Use hot dip galvanized pipe hangers and stainless-steel attachments for exterior applications. Zinc plated hangers and attachments are not acceptable for exterior use.

F. Use stainless-steel pipe hangers and stainless-steel attachments for corrosive environment applications. Zinc plated hangers and attachments are not acceptable for corrosive use.

G. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

H. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

I. Use padded hangers for piping that is subject to scratching.

J. Use thermal-hanger shield inserts for insulated piping and tubing.

K. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
   2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
   3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
   4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
   5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
   6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
   7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction occurs.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction occurs.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.

L. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

M. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment of 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.

N. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

O. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.

P. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.

6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

Q. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

S. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220548 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. The International Building Code and ASCE/SEI 7 Standard apply to all work associated with the seismic installation of all new mechanical piping and equipment. Refer to Structural drawings and ASCE/SEI 7 for seismic and wind loads and additional information.

1.2 SUMMARY

A. Section Includes:
1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Open-spring isolators.
5. Housed-spring isolators.
6. Restrained-spring isolators.
7. Housed-restrained-spring isolators.
8. Pipe-riser resilient supports.
9. Resilient pipe guides.
10. Air-spring isolators.
11. Restrained-air-spring isolators.
12. Elastomeric hangers.
13. Spring hangers.
14. Snubbers.
15. Restraints - rigid type.
16. Restraints - cable type.
17. Restraint accessories.
18. Post-installed concrete anchors.
19. Concrete inserts.

B. Related Requirements:

1. Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.
2. Section 230548 "Vibration and Seismic Controls for HVAC" for devices for HVAC equipment and systems.

1.3 DEFINITIONS

A. ASCE/SEI: American Society of Civil Engineers/Structural Engineering Institute.

B. IBC: International Building Code.

C. ICC-ES: ICC-Evaluation Service.

D. OSHPD: Office of Statewide Health Planning & Development (for the State of California).

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
   2. Include load rating for each wind-force-restraint fitting and assembly.
   3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic- and wind-force-restraint component.
   4. Annotate types and sizes of seismic restraints and accessories, complete with listing markings or report numbers and load rating in tension and compression as evaluated by an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction.
   5. Annotate to indicate application of each product submitted and compliance with requirements.
   6. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Shop Drawings:
   1. Detail fabrication and assembly of equipment bases.
   2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal:
   1. For each seismic-restraint and wind-load protection device, including seismic-restrained mounting, pipe-riser resilient support, snubber, seismic restraint, seismic-restraint accessory, concrete anchor and insert, and restrained isolation roof-curb rail that is required by this Section or is indicated on Drawings, submit the following:
      a. Seismic and Wind-Load Restraint, and Vibration Isolation Base Selection: Select vibration isolators, seismic and wind-load restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data.
      b. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification by professional engineer that riser system was examined for excessive stress and that none exists.
      c. Concrete Anchors and Inserts: Include calculations showing anticipated seismic and wind loads. Include certification that device is approved by an NRTL for seismic reinforcement use.

d. Seismic Design Calculations: Submit all input data and loading calculations prepared under "Seismic Design Calculations" Paragraph in "Performance Requirements" Article.
e. Wind-Load Design Calculations: Submit all static and dynamic loading calculations prepared under "Wind-Load Design Calculations" Paragraph in "Performance Requirements" Article.
f. Qualified Professional Engineer: All designated-design submittals for seismic- and wind-restraint calculations are to be signed and sealed by qualified professional engineer responsible for their preparation.

2. Seismic- and Wind-Restraint Detail Drawing:
   a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.
   b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
   c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply also with requirements in other Sections for equipment mounted outdoors.
3. All delegated-design submittals for seismic- and wind-restraint detail Drawings are to be signed and sealed by qualified professional engineer responsible for their preparation.
4. Product Listing, Preapproval, and Evaluation Documentation: By an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and basis for approval (tests or calculations).
5. Design Calculations for Vibration Isolation Devices: Calculate static and dynamic loading due to equipment weight and operating forces required to select proper vibration isolators, and to design vibration isolation bases.
6. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, and spring deflection changes. Include certification that riser system was examined for excessive stress and that none exists.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For professional engineer and testing agency.

C. Welding certificates.

D. Air-Spring Isolator Performance Certification: Include natural frequency, load, and damping test data performed by an independent agency.

E. Field quality-control reports.

F. Seismic Qualification Data: Provide special certification for designated seismic systems as indicated in ASCE/SEI 7 Paragraph 13.2.2, "Special Certification Requirements for Designated Seismic Systems" for all Designated Seismic Systems identified as such on Drawings or in the Specifications.
   1. Provide equipment manufacturer's written certification for each designated active mechanical seismic device and system, stating that it will remain operable following the design earthquake. Certification must be based on requirements of ASCE/SEI 7 and AHRI 1270, including shake table testing per ICC-ES AC156 or a similar nationally recognized testing standard procedure acceptable to authorities having jurisdiction or experience data as permitted by ASCE/SEI 7.
   2. Provide equipment manufacturer's written certification that components with hazardous contents maintain containment following the design earthquake by methods required in ASCE/SEI 7.
   3. Submit evidence demonstrating compliance with these requirements for approval to authorities having jurisdiction after review and acceptance by a licensed professional engineer.

G. Wind-Force Performance Certification: Provide special certification for components subject to high wind exposure and impact damage and designated on Drawings or in the Specifications to require wind-force performance certification.
   1. Provide equipment manufacturer's written certification for each designated device, stating that it will remain in place and operable following the design wind event and comply with all requirements of authorities having jurisdiction.
   2. Provide manufacturer's written certification for each designated louver, damper, or similar device, stating that it will remain in place and protect opening from penetration of windborne debris and comply with all requirements of authorities having jurisdiction.
   3. Certification must be based on ICC-ES or similar nationally recognized testing standard procedures acceptable to authorities having jurisdiction.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-spring isolators and restrained-air-spring isolators to include in operation and maintenance manuals.

B. Manufacturer's Inspection Report: Contractor shall submit factory-authorized service representative's final report indicating all restraints and isolation devices as being properly installed or requiring correction.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct testing indicated, be an NRTL as defined by OSHA in 29 CFR 1910.7, and be acceptable to authorities having jurisdiction.

B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Seismic- and Wind-Load-Restraint Device Load Ratings: Devices to be tested and rated in accordance with applicable code requirements and authorities having jurisdiction. Devices to be listed by a nationally recognized third party that requires periodic follow-up inspections and has a listing directory available to the public. Provide third-party listing by one or more of the following: an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.

1.8 COORDINATION

A. Coordinate with vibration isolation restraint manufacturer and the structural contractor/engineer of record to locate and size structural supports underneath vibration isolated restrained equipment (e.g. roof curbs and other similar equipment).

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic and wind- load control system.
   1. Seismic and Wind-Load Performance: Equipment shall withstand the effects of earthquake motions and high wind events determined in accordance with ASCE/SEI 7.

B. Seismic Design Calculations:
   1. Perform calculations to obtain force information necessary to properly select seismic-restraint devices, fasteners, and anchorage. Perform calculations using methods acceptable to applicable code authorities and as presented in ASCE/SEI 7. Where "ASCE/SEI 7" is used throughout this Section, it is to be understood that the edition referred to is the currently adopted edition.
      a. Data indicated below to be determined by Delegated-Design Contractor must be obtained by Contractor and must be included in individual component submittal packages.
      b. Coordinate seismic design calculations with wind-load calculations for equipment mounted outdoors. Comply with requirements in other Sections in addition to those in this Section for equipment mounted outdoors.
      c. Refer to structural drawings for seismic information and factors.

C. Wind-Load Design Calculations:
   1. Perform calculations to obtain force information necessary to properly select wind-load-restraint devices, fasteners, and anchorage. Perform calculations using methods acceptable to applicable code authorities and as presented in ASCE/SEI 7. Where "ASCE/SEI 7" is used throughout this Section, it is to be understood that the edition referred to is the currently adopted edition.
      a. Data indicated below that are specific to individual pieces of equipment must be obtained by Contractor and must be included in individual component submittal packages.
      b. Coordinate design wind-load calculations with seismic load calculations for equipment requiring both seismic and wind-load reinforcement. Comply with

requirements in other Sections in addition to those in this Section for equipment mounted outdoors.

c. Refer to structural drawings for wind load information and factors.

D. Fire/Smoke Resistance: Seismic- and wind-load-restraint devices that are not constructed of ferrous metals must have a maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by an NRTL in accordance with ASTM E84 or UL 723, and be so labeled.

E. Component Supports:
1. Load ratings, features, and applications of all reinforcement components must be based on testing standards of a nationally recognized testing agency.
2. All component support attachments must comply with force and displacement resistance requirements of ASCE/SEI 7.

2.2 GENERAL

A. Select vibration isolating units for the lowest operating speed of equipment, so designed that natural frequency of equipment and base mass is not less than 1.5 times the lowest operating frequency of the moving equipment, but not a multiple or harmonic of the base frequency. Furnish vibration isolation producing a uniform loading and deflection even when equipment weight is not evenly distributed, vibration isolation shall be stable during starting and stopping of equipment without excessive traverse and eccentric movement of equipment.

B. The installed vibration isolation system for each floor or ceiling mounted item of equipment shall have a maximum lateral motion under equipment start up and shut down conditions of 1/4 inch. Motions in excess shall be restrained by approved spring type mounting.

C. The type of isolation, base, and minimum static deflection shall be as required for each specific equipment application, but not less than that specified herein when supported on a solid concrete structural slab having a thickness of not less than four (4) inches.
1. Should vibration isolators installed for the equipment prove inadequate to prevent transmission of equipment vibrations to the building structure or limit equipment vibration originated noise in the building spaces to acceptable levels, the isolators shall be replaced with units having the largest deflection that can be practicably installed.

D. All springs installed out-of-doors shall be cadmium-plated, zinc electroplated or powder-coated after fabrication. Hardware and other metal parts shall be cadmium-plated or galvanized. Galvanizing shall meet ASTM Salt Spray Test Standards and Federal Test Standard No. 14.

E. All isolators installed out-of-doors shall have base plates with bolt holes for fastening the isolators to the support members.

2.3 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. California Dynamics Corporation
b. Isolation Technology, Inc
c. Kinetics Noise Control, Inc.
d. Mason Industries, Inc.
e. The VMC Group
f. Vibration Eliminator Co., Inc.
g. Vibration Isolation Co., Inc.
h. Vibration Mountings & Controls/Korfund.
i. Vibro-Acoustics, Inc.

2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties.
5. Surface Pattern: Waffle pattern.
6. Infused nonwoven cotton or synthetic fibers.
7. Load-bearing metal plates adhered to pads.

2.4 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. California Dynamics Corporation
b. Isolation Technology, Inc
c. Kinetics Noise Control, Inc.
d. Mason Industries, Inc.
e. The VMC Group
f. Vibration Eliminator Co., Inc.
g. Vibration Isolation Co., Inc.
h. Vibration Mountings & Controls/Korfund.
i. Vibro-Acoustics, Inc.
2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod (where required).
9. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.5 SNUBBERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Kinetics Noise Control, Inc
   2. Mason Industries, Inc.
   3. Novia; A Division of C&P
   4. Vibration Mountings & Controls, Inc

B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
   1. Post-Installed Concrete Anchor Bolts: Secure to concrete surface with post-installed concrete anchors. Anchors to be seismically prequalified in accordance with ACI 355.2 testing and designated in accordance with ACI 318.
   2. Preset Concrete Inserts: Seismically prequalified in accordance with ICC-ES AC446 testing.
   3. Anchors in Masonry: Design in accordance with TMS 402.
   4. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
   5. Resilient Cushion: Maximum 1/4-inch air gap, and minimum 1/4 inch thick.

2.6 RESTRAINTS - RIGID TYPE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. B-line, an Eaton business
   2. California Dynamics Corporation
   3. Hilti, Inc.
   4. Mason Industries, Inc.
   5. Unistrut; Part of Atkore International

B. Description: Shop- or field-fabricated bracing assembly made of AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53/A53M steel pipe as per NFPA 13, or other rigid steel brace member. Includes accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.7 RESTRAINTS - CABLE TYPE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Gripple Inc.
   2. Kinetics Noise Control, Inc.
   3. Mason Industries, Inc.
   4. Novia; A Division of C&P
   5. Vibration & Seismic Technologies, LLC
   6. Vibration Mountings & Controls, Inc.

B. Seismic-Restraint Cables: ASTM A603 galvanized-steel or ASTM A492 stainless steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for seismic-restraining cable service; with fittings attached by means of poured socket, swaged socket or mechanical (Flemish eye) loop.

C. Restraint cable assembly with cable fittings must comply with ASCE/SEI 19. All cable fittings and complete cable assembly must maintain the minimum cable breaking force. U-shaped cable clips and wedge-type end fittings do not comply and are unacceptable.

2.8 RESTRAINT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. B-line, an Eaton business
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.
4. Novia; A Division of C&P
5. TOLCO
6. Vibration & Seismic Technologies, LLC

B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.9 POST-INSTALLED CONCRETE ANCHORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. B-line, an Eaton business
2. Hilti, Inc.
3. Mason Industries, Inc.
4. Simpson Strong-Tie Co., Inc.
5. Unistrut; Atkore International.

B. Mechanical Anchor Bolts:

1. Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength for anchor and as tested according to ASTM E488/E488M.

C. Adhesive Anchor Bolts:
1. Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488/E488M.

D. Provide post-installed concrete anchors that have been prequalified for use in wind-load applications. Post-installed concrete anchors must comply with all requirements of ASCE/SEI 7, Ch. 13.
1. Prequalify post-installed anchors in concrete in accordance with ACI 355.2 or other approved qualification testing procedures.
2. Prequalify post-installed anchors in masonry in accordance with approved qualification procedures.

2.10 CONCRETE INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. B-line, an Eaton business
2. Hilti, Inc.
3. Mason Industries, Inc.
4. Simpson Strong-Tie Co., Inc.
5. Unistrut; Atkore International.

B. Provide preset concrete inserts that are seismically prequalified in accordance with ICC-ES AC466 testing.

C. Comply with ANSI/MSS SP-58.

2.11 VIBRATION ISOLATION EQUIPMENT BASES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. California Dynamics Corporation
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.
4. Novia; A Division of C&P
5. The VMC Group
6. Vibration Eliminator Co., Inc
7. Vibration Isolation
8. Vibration Mountings & Controls, Inc

B. Steel Rails: Factory-fabricated, welded, structural-steel rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.
   a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Rails shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.
   1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
      a. Include supports for suction and discharge elbows for pumps.

   2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.
   3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

D. Concrete Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
   1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
      a. Include supports for suction and discharge elbows for pumps.
   2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
   3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
   4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

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

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 INSTALLATION OF VIBRATION-CONTROL, WIND-LOAD CONTROL, AND SEISMIC-RESTRAINT DEVICES

A. Provide vibration-control devices for systems and equipment where indicated in Equipment Schedules or Vibration-Control Devices Schedules, where indicated on Drawings, or where Specifications indicate they are to be installed on specific equipment and systems.

B. Provide seismic-restraint and wind-load control devices for systems and equipment where indicated in Equipment Schedules or Seismic-Restraint Devices Schedules, where indicated on Drawings, where Specifications indicate they are to be installed on specific equipment and systems, and where required by applicable codes.

C. Housekeeping Pads:
1. All floor-mounted equipment shall be set on concrete housekeeping pads designed by the seismic engineer to meet the specific seismic requirements of each piece of floor mounted equipment.
2. Housekeeping pads shall rest on a structural floor and be constructed per the details provided by the seismic engineer.
3. Housekeeping pad shall be constructed as one continuous monolithic pour. Forms shall be constructed to allow removal after concrete pour without prying against pad.

D. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

E. Installation of vibration isolators, wind-load restraints, must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

F. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

G. Equipment Restraints:
1. Install seismic snubbers on equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.

2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install seismic-restraint, and wind-load-restraint devices using methods approved by an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction that provides required submittals for component.

H. Piping Restraints:
1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

I. Install seismic- and wind-load-restraint cables so they do not bend across edges of adjacent equipment or building structure.

J. Equipment Bases:
1. Fill concrete inertia bases, after installing base frame, with 3000-psi concrete; trowel to a smooth finish.
   a. Cast-in-place concrete materials and placement requirements are specified in Division 3.
2. Concrete Bases: Anchor equipment to concrete base according to supported equipment manufacturer's written instructions for seismic codes at Project site.
   a. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
   b. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base and anchor into structural concrete floor.
   c. Place and secure anchorage devices. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   d. Install anchor bolts to elevations required for proper attachment to supported equipment.
   e. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
   f. Cast-in-place concrete materials and placement requirements are specified in Division 3.

K. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction that provides required submittals for component.

L. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

M. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

N. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

O. Mechanical Anchor Bolts:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge-Type Anchor Bolts: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive-Type Anchor Bolts: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Provide flexible connections in piping systems where they cross structural seismic joints, expansion joints and other point where differential movement may occur. Provide adequate flexibility to accommodate differential movement as determined in accordance with ASCE/SEI 7. Comply with requirements in other sections for piping flexible connections.

3.5 INSTALLATION OF VIBRATION ISOLATION EQUIPMENT BASES

A. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

B. Coordinate dimensions of steel equipment rails and bases, concrete inertia bases, and restrained isolation roof-curb rails with requirements of isolated equipment specified in this and other Sections. Where dimensions of these bases are indicated on Drawings, dimensions may require adjustment to accommodate actual isolated equipment.

3.6 ADJUSTING

A. Adjust isolators after system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

3.7 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. Tests and Inspections:
   1. Perform tests and inspections with the assistance of a factory-authorized service representative.
   2. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
   3. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
   4. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
   5. Test no fewer than four of each type and size of installed anchors and fasteners selected by Architect.
   6. Test to 90 percent of rated proof load of device.
   7. Measure isolator restraint clearance.
   8. Measure isolator deflection.
   9. Verify snubber minimum clearances.

C. Remove and replace malfunctioning units and retest as specified above.

D. Units will be considered defective if they do not pass tests and inspections.

E. Prepare testing agency test and inspection reports.

F. Manufacturer's Inspection:
   1. A representative of the isolation materials manufacturer shall inspect the completed system and report in writing any installation errors, improperly selected isolation or restraint devices, or other faults that could affect the performance of the system.
   2. Contractor shall submit manufacturer's representative's final report indicating all isolation as being properly installed or requiring correction. If corrections are required, include steps to be taken to properly complete the isolation work.

3.8 VIBRATION ISOLATION AND SEISMIC-RESTRAINT SCHEDULE

A. Domestic Water Booster Pumps:
   1. Isolation Type: Elastomeric Isolation Pad
   2. Base Deflection: 0.4"
   3. Base Type: Integral to equipment.
   4. Remarks: Under skid.

B. Suspended Inline Pumps:
   1. Isolation Type: Spring Hanger
   2. Deflection: 0.25"

C. First Four (4) Pipe Hangers near Isolated Equipment:

1. Isolation Type: Spring Hanger
2. Deflection:
   a. Piping 3-inches and smaller: 0.75"
   b. Piping 4-inches to 6-inches: 1.5"
   c. Piping Larger than 6-inches: 2.5"

END OF SECTION 220548

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Valve tags.
4. Underground Warning Labels.
5. Warning tags.

1.3 ACTION 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. Pipe Label Schedule: Include a listing of all piping to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals. Include Service Abbreviation, Number Sequence, Valve Location and Valve Function.

1.4 QUALITY ASSURANCE

A. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
1. ANSI / ASME A13.1: "Scheme for the Identification of Piping Systems"
2. ANSI Z535.1: "Safety Color Code"
3. NFPA-99C; CGA C-9-2002 "Standard Industry Color Coding Recommendations for Medical Gases."

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Labels for Equipment:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Brady Corporation
      b. Brimar Industries, Inc.
      c. Carlton Industries, LP
      d. Craftmark Pipe Markers
      e. Kolbi Pipe Marker Co.
      f. LEM Products Inc.
      g. Seton Identification Products
   2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
   3. Letter Color: White.
   4. Background Color: Black.
   5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
   6. Minimum Label Size: Length and width vary for required label content, but not less than 4 by 2-1/2 inch.
   7. Minimum Letter Size: 3/4 inch.
   8. Fasteners: Stainless-steel rivets or self-tapping screws, or double face adhesive.
   9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Equipment Markers: Engraved phenolic plastic nameplates with 3/4-inch white surface and 1/4-inch tall black lettering.
   1. Fasteners: Epoxy.

C. Label Content: Include equipment's Drawing designation or unique equipment number as indicated on the mechanical drawings and schedules.

2.2 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Brady Corporation
   2. Brimar Industries, Inc.
   3. Carlton Industries, LP
   4. Craftmark Pipe Markers
   5. Kolbi Pipe Marker Co.
   6. LEM Products Inc.
   7. Seton Identification Products

B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic

1. For Pipes With an Overall Pipe Diameter of 8" or less: Formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
2. For Pipes With an Overall Pipe Diameter Larger Than 8": Formed to partially cover circumference of pipe and to attach to pipe with no less than two nylon strap-on fasteners.

D. Self-Adhesive Pipe Labels:
1. For Pipes With an Overall Pipe Diameter of 3/4" or less: Printed plastic with contact-type, permanent-adhesive backing.

E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: Size letters according to ASME A13.1 for piping.

2.3 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Brady Corporation
2. Brimar Industries, Inc.
3. Carlton Industries, LP
4. Craftmark Pipe Markers
5. Kolbi Pipe Marker Co.
6. LEM Products Inc.
7. Seton Identification Products

B. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
1. Tag Material: Brass, 1-1/2 diameter, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware. If necessary, to accommodate longer abbreviations or number sequences increase tag size to 2" in diameter.
2. Fasteners: Brass wire-link chain or beaded chain.

C. Valve Markers: Engraved phenolic plastic nameplates with 3/4-inch white surface and 1/4-inch tall black lettering.
1. Fasteners: Epoxy.

D. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.4 UNDERGROUND PIPE WARNING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Brady Corporation
   2. Brimar Industries, Inc.
   3. Carlton Industries, LP
   4. Craftmark Pipe Markers
   5. Kolbi Pipe Marker Co.
   6. LEM Products Inc.
   7. Seton Identification Products

B. Description: Preprinted detectable underground tape of B-721 metal detectable polyester material with subsurface graphics to seal the legend from acids, alkalis and other destructive soil substances.
   1. Size: Minimum 5 mils thick, 4 inches wide with minimum tensile strength of 120 lbs.
   2. Nomenclature: Utilize manufactures standard legends to identify underground piping. Provide a continuous printed message similar to "Caution Water Line Buried Below"
   3. Color: Utilize manufactures standard colors.

2.5 WARNING TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Brady Corporation
   2. Brimar Industries, Inc.
   3. Carlton Industries, LP
   4. Craftmark Pipe Markers
   5. Kolbi Pipe Marker Co.
   6. LEM Products Inc.
   7. Seton Identification Products

B. 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: Brass grommet and wire.
   3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
   4. Color: Safety 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 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 plumbing equipment.

B. Locate equipment labels where accessible and visible.

C. For equipment located above the ceiling, in addition to a label on the equipment, equipment markers are to be permanently affixed to the ceiling grid framing as near to the item as possible using epoxy glue. Where hard ceilings are used, the label is to be affixed to the frame of the access panel for the unit.

3.4 PIPE COLOR CODING

A. Paint exposed and insulated piping in finished areas and mechanical rooms.
   1. Finished Areas: Color shall be the same as the adjacent surface. Color by Architect.
   2. Mechanical Rooms: Color shall be the same as the pipe label background color.
   3. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
   4. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Exterior non-insulated piping shall be painted with two coats of rust inhibitive paint. Colors shall be approved by the Owner after a sample is provided for each service. Do not paint aluminum jackets.

C. Do not paint exposed copper piping or galvanized piping.

D. Do not paint aluminum or stainless-steel jackets.

E. Painting of piping is specified in Division 09.

3.5 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, crawl spaces and plenums; and exterior exposed locations as follows:
   1. Spaced at maximum intervals of 20 feet along each straight run.
   2. Near each valve and control device.

3. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
4. Near each change in direction.
5. Above and below every floor penetration and on either side of every wall penetration.
6. At least one pipe marker per pipe in every room.
7. At access doors, manholes, and similar access points that permit view of concealed piping.
8. Near major equipment items and other points of origination and termination.
9. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

C. Vertical Piping: Provide strip of adhesive on the inside of pretensioned pipe labels to further secure the marker in a permanent position.

D. Pipe Label Color Schedule:
1. Domestic Water Piping
   a. Background: Safety green.
   b. Letter Colors: White.
   c. Designation: COLD WATER, HOT WATER, HOT WATER RECIRC.
2. Sanitary Waste and Vent Piping:
   a. Background Color: Safety black.
   b. Letter Color: White.
   c. Designation: SANITARY DRAIN, VENT.
3. Storm and Overflow Drainage Piping:
   a. Background Color: Safety black.
   b. Letter Color: White.
   c. Designation: STORM DRAIN, OVERFLOW DRAIN.

3.6 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve Tags for Shutoff Valves in Medical Gas and Vacuum Systems: Tag shall contain the name or chemical symbol of the specific system, the room served, and a caution to not close or open the valve except in emergency. The operating pressure of the gas system shall be included on the tag if the system operates at pressures other than the standard gauge pressure of 50psi to 55 psi, 15 in to 30 in HgV (Vacuum) or 160-185 psi (Nitrogen or Instrument Air).

C. Ceiling valve markers shall be provided for valves above ceilings. Attach valve marker to ceiling grid directly below the valve.

3.7 UNDERGROUND PIPE WARNING

A. Provide continuous underground pipe marking tape above all plumbing pipes buried beneath the ground.

B. Provide a continuous length of tape 6" below the finished earth surface directly above the buried pipe.

C. Provide a second continuous length of tape 12" above the top of the buried pipe if the top of the pipe is lower than 36" from the top of the finished earth surface.

D. If tape cannot be continuous then it must overlap by ten feet at any end.

3.8 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulation for the following plumbing services:
   1. Plumbing equipment.
   2. Plumbing piping.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail attachment and covering of heat tracing inside insulation.
   3. Detail insulation application at pipe expansion joints for each type of insulation.
   4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   5. Detail removable insulation at piping specialties, equipment connections, and access panels.
   6. Detail removable insulation at 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.

C. Samples:
   1. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.4 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

B. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.
1. Piping Mockups:
   a. One 10-foot section of NPS 2 straight pipe.
   b. One each of a 90-degree threaded, welded, and flanged elbow.
   c. One each of a threaded, welded, and flanged tee fitting.
   d. One NPS 2 or smaller valve, and one NPS 2-1/2 or larger valve.
   e. Four support hangers including hanger shield and insert.
   f. One threaded strainer and one flanged strainer with removable portion of insulation.
   g. One threaded reducer and one welded reducer.
   h. One pressure temperature tap.
   i. One mechanical coupling.
2. Equipment Mockups: One tank or vessel.
3. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
4. Notify Architect seven days in advance of dates and times when mockups will be constructed.
5. Obtain Architect's approval of mockups before starting insulation application.
6. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
7. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
8. Demolish and remove mockups when directed.

C. Comply with the following applicable codes and standards and other requirements specified for miscellaneous components:
1. ICC - International Energy Conservation Code (ICC-IECC)
2. ANSI/ASHRAE/IES Standard 90.1-2016 -- Energy Standard for Buildings Except Low-Rise Residential Buildings
3. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields.

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in PART 3 - EXECUTION articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Aeroflex USA, Inc.
      b. Armacell LLC
      c. K-Flex USA

G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed Corporation
b. Johns Manville; a Berkshire Hathaway company
c. Knauf Insulation
d. Manson Insulation Inc.
e. Owens Corning

H. Mineral-Fiber, Preformed Pipe Insulation:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Johns Manville; a Berkshire Hathaway company
b. Knauf Insulation
c. Manson Insulation Inc.
d. Owens Corning
2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ or ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

I. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. CertainTeed Corporation
b. Johns Manville; a Berkshire Hathaway company
c. Knauf Insulation
d. Manson Insulation Inc.
e. Owens Corning

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. For indoor applications, use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Aeroflex USA, Inc.

2. Armacell LLC
3. Childers Brand; H. B. Fuller Construction Products
4. Dow Corning Corporatio
5. Eagle Bridges - Marathon Industries
6. Foster Brand; H. B. Fuller Construction Products.
7. Johns Manville; a Berkshire Hathaway company
8. K-Flex USA
9. P.I.C. Plastics, Inc.
10. Mon-Eco Industries, Inc.
11. Speedline Corporation
12. Vimasco Corporation.

D. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

F. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

B. For indoor applications, use mastics that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Childers Brand; H. B. Fuller Construction Products
2. Eagle Bridges - Marathon Industries
3. Foster Brand; H. B. Fuller Construction Products.
4. Knauf Insulation
5. Mon-Eco Industries, Inc.
6. Vimasco Corporation

D. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
4. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: 60 percent by volume and 66 percent by weight.
4. Color: White.

2.5 LAGGING ADHESIVES

A. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Childers Brand; H. B. Fuller Construction Products
2. Foster Brand; H. B. Fuller Construction Products.
3. Vimasco Corporation

C. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
2. Service Temperature Range: 0 to plus 180 deg F.
3. Color: White.

2.6 SEALANTS

A. Use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Childers Brand; H. B. Fuller Construction Products
2. Eagle Bridges - Marathon Industries
3. Foster Brand; H. B. Fuller Construction Products.
4. Knauf Insulation
5. Mon-Eco Industries, Inc.
6. Pittsburgh Corning Corporation
7. Vimasco Corporation

C. FSK and Metal Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.

D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Alpha Associates, Inc

2.9 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. Metal Jacket:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ITW Insulation Systems; Illinois Tool Works, Inc.
b. RPR Products, Inc.
2. Aluminum Jacket: Comply with ASTM B 209, ASTM C 1729, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
a. Factory cut and rolled to size.
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
e. Factory-Fabricated Fitting Covers:
1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
    a. Factory cut and rolled to size.
    b. Material, finish, and thickness are indicated in field-applied jacket schedules.
    c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
    d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
    e. Factory-Fabricated Fitting Covers:
        1) Same material, finish, and thickness as jacket.
        2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
        3) Tee covers.
        4) Flange and union covers.
        5) End caps.
        6) Beveled collars.
        7) Valve covers.
        8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

C. Underground Direct-Buried Jacket: 125-mil- thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Pittsburgh Corning Corporation
    b. Polyguard Products, Inc

D. Self-Adhesive Outdoor Jacket: 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with white aluminum-foil facing.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Polyguard Products, Inc.
2. Warranty: Minimum 10-year warranty that water will not leak directly through membrane as a result of deterioration of the membrane caused by ordinary wear and tear.

2.10 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
   1. Width: 3 inches.
   2. Thickness: 6.5 mils.
   3. Adhesion: 90 ounces force/inch in width.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch in width.
   6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
   1. Width: 2 inches.
   2. Thickness: 3.7 mils.
   3. Adhesion: 100 ounces force/inch in width.
   4. Elongation: 5 percent.
   5. Tensile Strength: 34 lbf/inch in width.

2.11 SECUREMENTS

A. Bands:
   1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal.
   2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.

B. Insulation Pins and Hangers:
   1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch diameter shank, length to suit depth of insulation indicated.
   2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
   3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
      a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
      b. Spindle: Aluminum, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
      c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
   4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
      a. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
      b. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.

c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
   a. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   b. Spindle: Aluminum, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
   c. Adhesive-backed base with a peel-off protective cover.
6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

2.12 CORNER ANGLES

A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

B. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.

2.13 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Buckaroos, Inc.
   b. Engineered Brass Company
   c. Insul-Tect Products Co.
   d. McGuire Manufacturing
   e. Oatey
   f. Plumberex Specialty Produ... Plumberex Specialty Products, Inc.
   g. Truebro
   h. Zurn Industries, LLC
2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Truebro
      b. Zurn Industries, LLC
   2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

   1. Verify that systems and equipment to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.

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

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
   1. For exterior, above-grade piping: Before insulating, apply a corrosion coating to insulated surfaces as follows:
      a. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
      b. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
   a. For below-ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
   1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:
   1. Pipe: Install insulation continuously through floor penetrations.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 INSTALLATION OF PIPE INSULATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

   1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
   2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
   3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
   4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
   5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
   6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
   7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated or required for maintenace. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

3.6 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

A. Mineral-Fiber, Pipe, and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
    a. Do not weld anchor pins to ASME-labeled pressure vessels.
    b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
    d. Do not overcompress insulation during installation.

e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
f. Impale insulation over anchor pins and attach speed washers.
g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches.
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
1. Apply 50 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

3.7 INSTALLATION OF CALCIUM SILICATE INSULATION

A. Insulation Installation on Domestic Water Boiler Breechings:
1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation material.
2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. On exposed applications without metal jacket, finish insulation surface with a skim coat of mineral-fiber, hydraulic-setting cement. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth. Thin finish coat to achieve smooth, uniform finish.

3.8 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
   2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
   3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.
   4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
   4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
   2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

   1. Install preformed sections of cellular-glass insulation to valve body.
   2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.

3.9 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
   1. Install pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.

4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

E. Provide latex-based, UV resistant protective coating for outdoor applications.

3.10 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
   3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   4. Install insulation to flanges as specified for flange insulation application.

3.11 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
   1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
   2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
   3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:
   1. Draw jacket material smooth and tight.
   2. Install lap or joint strips with same material as jacket.
   3. Secure jacket to insulation with manufacturer's recommended adhesive.
   4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
   5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
   1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.12 FIELD QUALITY CONTROL

A. If workmanship is of questionable quality, the contractor shall perform tests and inspections as directed by the Architect.

B. Tests and Inspections:

   1. Inspect field insulated equipment, pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.13 INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.14 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment that is not factory insulated.

C. Domestic hot-water storage tank insulation shall be the following, of thickness to provide an R-value of 12.5:
1. Mineral-fiber pipe and tank.

3.15 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:
1. NPS 1 and Smaller: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1/2 inch thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch.
2. NPS 1-1/4 and Larger: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Domestic Hot and Recirculated Hot Water:
1. NPS 1 and Smaller: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1/2 inch thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch.
2. NPS 1-1/4 and Larger: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

C. Domestic Potable Chilled Water (Drinking Fountains):
1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 1 inch thick.

D. Stormwater and Overflow (First Ten Feet From Drain Body and All Horizontal Pipe):

1. All Pipe Sizes: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

E. Roof Drain and Overflow Drain Bodies:
1. All Pipe Sizes: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

F. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities (ADA):
1. All Pipe Sizes: Insulation/protection shall be the following:
   a. Protective Shielding Pipe Covers or Protective Shielding Piping Enclosures.

G. Floor Drains, Traps, and Sanitary Drain Piping within 20 Feet of Drain Receiving AHU/FCU Condensate and Equipment Drain Water below 60 Deg F:
1. All Pipe Sizes: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

H. Hot Service Drains:
1. All Pipe Sizes: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.

I. Hot Service Vents:
1. All Pipe Sizes: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.

J. For piping smaller than 1 1/2 inches and located in partitions within conditioned spaces, reduction of the scheduled thickness by 1 inch shall be permitted, but not to a thickness less than 1 inch.

3.16 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Cold Water:
1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 2 inches thick.

3.17 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Piping, Concealed:

1. None.

C. Piping, Exposed:

1. Woven Glass-Fiber Fabric.

D. Equipment, Concealed:

1. None.

E. Equipment, Exposed:
1. None.

3.18 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Piping, Concealed:

1. None.

C. Piping, Exposed:
1. Aluminum, Stucco Embossed with Z-Shaped Locking Seam per the requirements of ASTM C1729. Minimum jacket thickness shall be based on the outer insulation diameter:
   a. 8-inches and smaller: 0.024 inches thick.
   b. 10-inches to 36-inches: 0.032 inches thick.
   c. 38-inches and larger: 0.040 inches thick.
2. Stainless Steel, Type 304 or Type 316, Stucco Embossed with Z-Shaped Locking Seam: 0.024 inch thick.
3. Self-Adhesive Outdoor Jacket: 60-mil- thick.

D. Equipment, Concealed:

1. None.

E. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
1. Aluminum, Stucco Embossed: 0.040 inch thick.
2. Stainless Steel, Type 304 or Type 316, Stucco Embossed: 0.024 inch thick.

F. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
1. Aluminum, Stucco Embossed with 1-1/4-Inch- Deep Corrugations: 0.040 inch thick.
2. Stainless Steel, Type 304 or Type 316, Stucco Embossed, with 1-1/4-Inch- Deep Corrugations: 0.024 inch thick.

3.19 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 220700

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 SUMMARY

A. Section Includes:
   1. Domestic water piping.

B. Contractor shall perform all work within the building and to a point five (5) feet from the building wall, unless otherwise noted.
   1. Contractor shall coordinate with site water services provided under another Division.
   2. The contractor shall make the final connection of the building water service to the site water service.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Pipes, tubes, fittings, and specialties for each type of piping.
   2. Joining materials.
   3. Encasement for piping.
   4. Transition fittings.
   5. Dielectric fittings.

1.4 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

1.5 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
   1. Notify Owner no fewer than ten days in advance of proposed interruption of water service.
   2. Do not interrupt water service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping: 125 psig unless otherwise indicated.

2.2 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G. Plastic piping components shall be marked with "NSF-pw."

C. Comply with NSF 372 for low lead.

D. All pipe and fittings shall be from a United States domestic manufacturer.

2.3 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L and ASTM B 88, Type M water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

F. Copper Unions:
1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint.

G. Copper Push-on-Joint Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Apollo Valves; Conbraco Industries, Inc.
    b. Elkhart Products Corporation
    c. Mueller Industries, Inc.
    d. NIBCO INC.
    e. Viega LLC
2. Description:
    a. Cast- or wrought-copper press-connect fitting complying with ASME B16.51.

b. Stainless-steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.

2.4 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe:
1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Standard-Pattern, Mechanical-Joint Fittings:
1. AWWA C110/A21.10, ductile or gray iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.

D. Appurtenances for Grooved-End, Ductile-Iron Pipe:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Shurjoint Piping Products USA Inc
b. Smith-Cooper International
c. Star Pipe Products
d. Victaulic Company
2. Fittings for Grooved-End, Ductile-Iron Pipe: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions that match pipe.
3. Mechanical Couplings for Grooved-End, Ductile-Iron-Piping:
a. AWWA C606 for ductile-iron-pipe dimensions.
b. Ferrous housing sections.
c. EPDM-rubber gaskets suitable for hot and cold water.
d. Bolts and nuts.
e. Minimum Pressure Rating: 250 psig.

2.5 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:
1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.6 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Standard: ASTM A 674 or AWWA C105/A 21.5.

B. Material: Linear low-density polyethylene film of 0.008-inch minimum thickness.

C. Form: Tube.

D. Color: Black or natural.

2.7 TRANSITION FITTINGS

A. General Requirements:
1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.
4. Description:
   a. CPVC one-piece fitting with manufacturer's equivalent dimensions.
   b. One end with threaded brass insert and one solvent-cement-socket end.

2.8 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. WATTS
   b. Wilkins
   c. Zurn Industries, LLC
2. Standard: ASSE 1079.
3. Pressure Rating: 150 psig minimum at 180 deg F.
4. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. WATTS
   b. Wilkins
   c. Zurn Industries, LLC
2. Standard: ASSE 1079.
3. Factory-fabricated, bolted, companion-flange assembly.
4. Pressure Rating: 150 psig minimum at 180 deg F.

5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Advance Products & Systems, Inc
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.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 STORAGE AND PROTECTION

A. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

B. Storage and protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

C. Store piping on a flat surface to prevent unwanted deformation.

3.3 EXAMINATION

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

B. Examine roughing-in for piping to verify actual locations of piping connections before equipment and fixture installation.

C. Examine walls, floors and roofs for suitable conditions where piping will be installed.

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

3.4 INSTALLATION OF PIPING

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install underground pipe in PE encasement according to ASTM A 674 or AWWA C105/A21.5.

E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance.

F. Install shutoff valve immediately upstream of each dielectric fitting.

G. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

H. Install seismic restraints on piping.

I. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

J. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

K. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

L. Install piping to permit valve servicing.

M. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

N. Install piping free of sags and bends.

O. Install fittings for changes in direction and branch connections.

P. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

Q. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump.

R. Install thermostats in hot-water circulation piping.

S. Install thermometers on inlet and outlet piping from each water heater.

T. Install sleeves for piping penetrations of interior walls, ceilings, and floors.
   1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install sleeve seals for piping penetrations of exterior concrete walls and slabs.
   1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install escutcheons for exposed piping penetrations of finished walls, ceilings, and floors.
   1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.5 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.

F. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

G. Joint Construction for Grooved-End Steel Piping: Make joints according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

H. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

I. Joints for PEX Tubing: Join according to ASTM F 1807 for metal insert and copper crimp ring fittings and ASTM F 1960 for cold expansion fittings and reinforcing rings.

J. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.6 INSTALLATION OF TRANSITION FITTINGS

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:
   1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
   2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings.

3.7 INSTALLATION OF DIELECTRIC FITTINGS

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.8 INSTALLATION OF VALVES

A. General valve installation requirements are specified in Section 220523, "Valves for Plumbing Piping."

3.9 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

C. Install hangers for piping and tubing, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Install vinyl-coated hangers for PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Install vinyl-coated hangers for PEX tubing, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

F. Support horizontal piping within 12 inches of each fitting.

G. Support vertical runs of piping and tubing to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

H. Support vertical runs of PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.10 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
   1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
   2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
   3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
   4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.11 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.12 FIELD QUALITY CONTROL

A. Perform the following tests and inspections in the presence of the Commissioning Agent, Owner, Architect or his representative:
   1. Piping Inspections:
      a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.

b. During installation, notify authorities having jurisdiction at least two days before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
   1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
   2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:
   a. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.
   b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
   c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
   e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
   f. Prepare reports for tests and for corrective action required.

B. Water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. Provide minimum 48 hours notice prior to testing to allow the Architect, Engineer, Commissioning Agent, Owner or his representative the opportunity to attend.

E. Tests shall be conducted and written report of testing submitted before any insulation is installed. Insulation installed prior to tests shall be removed.

3.13 ADJUSTING

A. Perform the following adjustments before operation:
   1. Close drain valves, hydrants, and hose bibbs.
   2. Open shutoff valves to fully open position.
   3. Open throttling valves to proper setting.
   4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
      a. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.14 CLEANING

A. Clean and disinfect potable domestic water piping as follows:
   1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
   2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
      a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
      b. Fill and isolate system according to either of the following:
         1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
         2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
      c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
      d. Repeat procedures if biological examination shows contamination.
      e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.15 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Under-building-slab, domestic water and building-service piping, NPS 3 and smaller, shall be the following:
   1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.

D. Under-building-slab, trap-seal primer piping shall be one the following:
   1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.

E. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
   1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.
   2. Hard copper tube, ASTM B 88, Type L; copper push-on-joint fittings; and push-on joints.

F. Aboveground domestic water piping, NPS 2-1/2 and larger, shall be the following:
   1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.

G. Aboveground, trap-seal primer piping shall be one of the following:
   1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.
   2. Hard copper tube, ASTM B 88, Type L; copper push-on-joint fittings; and push-on joints.

3.16 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   1. Shutoff Duty:
      a. Use full-port ball valves for piping NPS 2 and smaller.
      b. Use ball or butterfly valves with flanged ends for piping NPS 2-1/2 and larger.
   2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
   3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
   4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Strainers.
7. Hose bibbs.
8. Wall hydrants.
9. Post hydrants.
10. Drain valves.
11. Shock absorbers/Water-hammer arresters.
12. Trap-seal primer valves.
13. Flexible connectors.
14. Water meters.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 Annex G.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

A. Hose-Connection Vacuum Breakers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Apollo Valves; Conbraco Industries, Inc.
      b. MIFAB, Inc
      c. WATTS
      d. Zurn Industries, LLC
   2. Standard: ASSE 1011.
   3. Body: Bronze, nonremovable, with manual drain.
   4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
   5. Finish: Rough bronze.

B. Anti-Siphon Pressure Vacuum Breakers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Ames Fire & Waterworks; A WATTS Brand
      b. Apollo Valves; Conbraco Industries, Inc.
      c. WATTS
      d. Zurn Industries, LLC
   2. Standard: ASSE 1020.
   3. Operation: Continuous-pressure applications.
   4. Pressure Loss: 5 psig maximum, through middle third of flow range.
   5. Accessories:
      a. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS

A. Beverage-Dispensing-Equipment Backflow Preventers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Apollo Valves; Conbraco Industries, Inc.
      b. WATTS
      c. Zurn Industries, LLC

2. Standard: ASSE 1022.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 or NPS 3/8 as indicated on drawings.
5. Body: Stainless steel.
6. End Connections: Threaded.
7. Accessories:
    a. Inlet strainer; material to match backflow preventer body.

B. Carbonated-Beverage-Dispenser, Dual-Check-Valve Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Cash Acme.
    b. Lancer Corporation
    c. WATTS
2. Standard: ASSE 1032.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 or NPS 3/8.
5. Body: Stainless steel.
6. End Connections: Threaded.
7. Accessories:
    a. Inlet strainer; material to match backflow preventer body.

C. Hose-Connection Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Apollo Valves; Conbraco Industries, Inc.
    b. WATTS
    c. Woodford Manufacturing Company.
2. Standard: ASSE 1052.
3. Operation: Up to 10-foot head of water back pressure.
4. Inlet Size: NPS 1/2 or NPS 3/4.
5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
6. Capacity: At least 3-gpm flow.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Apollo Valves; Conbraco Industries, Inc.
    b. WATTS
    c. Zurn Industries, LLC
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Size: Same as connected piping. Refer to drawings.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
6. Valves for Booster Heater Water Supply: Include integral bypass.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

2.6 BALANCING VALVES

A. Copper Alloy Calibrated Balancing Valves, ½" – 2":
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Armstrong International, Inc
      b. Flo Fab Inc
      c. ITT Corporation
      d. NIBCO INC.
      e. TACO Comfort Solutions, Inc.
      f. WATTS
   2. Type: Ball or Y-pattern globe valve with position indicator, two checked readout ports with drip caps and memory-setting indicator.
   3. Body: Brass or bronze.
   4. Size: As required for scheduled flow, but not larger than NPS 2.
   5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.7 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Point-of-Use, Thermostatic, Water Tempering Valves:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Leonard LF-170, 270 or 370 Series or comparable product by one of the following:
      a. Apollo Valves; Conbraco Industries, Inc.
      b. Bradley Corporation
      c. Lawler Manufacturing Company, Inc
      d. Leonard Valve Company
      e. POWERS; A WATTS Brand
      f. WATTS
      g. Zurn Industries, LLC
   2. Standard: ASSE 1070, thermostatically controlled, water tempering valve.
   3. Pressure Rating: 125 psig minimum unless otherwise indicated.
   4. Material: Lead-free, bronze body with corrosion-resistant interior components.
   5. Temperature Control: Adjustable, locking (tamper resistant).
   6. Inlets and Outlet: Threaded or compression fittings, integral check valves on inlets.
   7. Finish: Rough or chrome-plated bronze.
   8. Pressure-Temperature:
      a. Minimum Flow: 0.25 GPM
      b. Maximum Pressure: 125 PSIG.
      c. Maximum Hot Water temperature: 200°F.
      d. Approach Temperature 5°F above set point.
      e. Temperature Adjustment Range: 90°F -140°F
      f. Tempered-Water Setting: 105 deg F.
   9. Accessories:
      a. Cold water by-pass port (single fixture only). Not required for single handle or sensor faucet installations.
      b. Mounting bracket.
      c. Ball valves.

d. For concealed wall mounted valves, provide recessed cabinet, white enamel, 18-gauge body and door, with left-hand hinge, plexiglas window in door and inlet/outlet knock-out holes for mounting flexibility.

B. Emergency, Safety-Fixture, Thermostatic, Water Tempering Valves:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Bradley Navigator Series or comparable product by one of the following:
   a. Apollo Valves; Conbraco Industries, Inc.
   b. Bradley Corporation
   c. Lawler Manufacturing Company, Inc
   d. Leonard Valve Company
   e. POWERS; A WATTS Brand
   f. WATTS
   g. Zurn Industries, LLC
2. Type: Thermostatically controlled, emergency fixture thermostatic water mixing valve.
3. Standard: ANSI Z358.1, thermostatically controlled, water tempering valve.
4. Pressure Rating: 125 psig minimum unless otherwise indicated.
5. Material: Lead-free, bronze body with corrosion-resistant interior components.
6. Temperature Control: Adjustable.
7. Accessories: Manual temperature control, strainer check stops on hot- and cold-water supplies, inlet/outlet shutoff, built-in cold water bypass.
8. Inlets and Outlet: Threaded.
9. Finish: Rough or chrome-plated bronze.
10. Tempered-Water Setting: 85 deg F.
11. Tempered-Water Design Flow Rate:
    a. Emergency Eyewash Units: Minimum flushing fluid of 0.4 gpm @ 30 psi.
    b. Emergency Eye/Facewash Units & Drench Hoses: Minimum flushing fluid of 3 gpm @ 30 psi.
    c. Emergency Showers: Minimum flushing fluid of 20 gpm @ 30 psi.
    d. Based on manufacturer's requirements, emergency shower and combination units shall be provided with a flow restrictor as required to utilize a thermostatic mixing valve.
12. For concealed wall mounted valves, provide recessed cabinet, white enamel, 18-gauge body and door, with left-hand hinge, plexiglas window in door and inlet/outlet knock-out holes for mounting flexibility.

2.8 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:
1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated 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: 0.125 inch.
6. Drain: Factory-installed, hose-end drain valve.

2.9 HOSE BIBBS

A. Hose Bibbs (HB-1):
1. Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith 5670-H or comparable product by one of the following:
   a. Jay R. Smith Mfg. Co
   b. Josam Company
   c. MIFAB, Inc
   d. WATTS
   e. Zurn Industries, LLC
2. Standard: ASME A112.18.1 for sediment faucets.
3. Type: Exposed, bent nose hose valve with flange and vacuum breaker, not subject to freezing.
4. Body Material: Bronze.
5. Seat: Bronze, replaceable.
6. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
7. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
8. Pressure Rating: 125 psig.
9. Vacuum Breaker: Integral, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
10. Finish
    a. Equipment Rooms: Rough bronze, or chrome or nickel plated.
    b. Service Areas: Rough bronze.
    c. Finished Rooms: Chrome or nickel plated.
11. Operation
    a. Equipment Rooms: Wheel handle or operating key.
    b. Service Areas: Wheel handle.
    c. Finished Rooms: Operating key.
12. Include operating key with each operating-key hose bibb.
13. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.10 WALL HYDRANTS

A. Exterior, Nonfreeze Wall Hydrants (WH-1):
1. Basis-of-Design Product: Subject to compliance with requirements, provide Josam 71300 Series or comparable product by one of the following:
   a. Jay R. Smith Mfg. Co
   b. Josam Company
   c. MIFAB, Inc
   d. WATTS
   e. Zurn Industries, LLC
2. Standard: ASME A112.18.1 for concealed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.

8. Box: Deep, flush mounted with cover, cylinder secured lock.
9. Box: Stainless steel.
10. Cover Finish: Cast satin brush nickel.
11. Vacuum Breaker:
    a. Nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
    b. Garden-hose thread complying with ASME B1.20.7 on outlet.
12. Operating Keys(s): One with each wall hydrant.

B. Exterior, Nonfreeze, Hot- and Cold-Water Wall Hydrants (WH-2):
1. Basis-of-Design Product: Subject to compliance with requirements, provide Josam 71650 Series or comparable product by one of the following:
    a. Jay R. Smith Mfg. Co
    b. Josam Company
    c. MIFAB, Inc
    d. WATTS
    e. Zurn Industries, LLC
2. Standard: ASME A112.18.1 for concealed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rods: Of length required to match wall thickness. Include wall clamps.
6. Inlet: NPS 3/4.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounted with cover, cylinder secured lock.
9. Box: Stainless steel.
10. Cover Finish: Cast satin brush nickel.
11. Vacuum Breaker:
    a. Nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
    b. Garden-hose thread complying with ASME B1.20.7 on outlet.
12. Operating Key(s): One with each wall hydrant.

C. Interior Wall Hydrants (WH-3):
1. Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith 5518 Series or comparable product by one of the following:
    a. Jay R. Smith Mfg. Co
    b. Josam Company
    c. MIFAB, Inc
    d. WATTS
    e. Zurn Industries, LLC
2. Standard: ASME A112.18.1 for concealed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.

8. Box: Narrow, flush mounted with cover, cylinder secured lock.
9. Cover Finish: Brush nickel.
10. Vacuum Breaker:
    a. Nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
    b. Garden-hose thread complying with ASME B1.20.7 on outlet.
11. Operating Keys(s): One with each wall hydrant.

2.11 POST HYDRANTS

A. Nonfreeze, Nondraining, Roof Hydrants (RH-1):
1. Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith 5903 Series or comparable product by one of the following:
    a. Jay R. Smith Mfg. Co
    b. Josam Company
    c. MIFAB, Inc
    d. WATTS
    e. Zurn Industries, LLC
2. Operation: Lever-piston operating mechanism and nondraining stainless-steel water-storage reservoir, designed without drain.
3. Pressure Rating: 125 psig.
4. Casing: Galvanized.
5. Roof Mount Assembly: Deck flange, underdeck clamp, flashing clamp.
6. Length: 24" above finished roof.
7. Inlet: NPS 3/4 threaded.
8. Outlet: NPS ¾ garden-hose thread complying with ASME B1.20.7
9. Provide in-line double check backflow preventer on water service inlet.

2.12 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:
1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.13 SHOCK ABSORBERS/WATER-HAMMER ARRESTERS

A. Shock Absorbers/Water-Hammer Arresters:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AMTROL, Inc.
b. Jay R. Smith Mfg. Co
c. Josam Company
d. MIFAB, Inc
e. Oatey
f. Precision Plumbing Products
g. Sioux Chief Manufacturing Company, Inc.
h. WATTS
i. Zurn Industries, LLC

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes B through F.
   a. Shock absorbers shall be the same size as the line on which they are installed, up to 1" pipe size. Pipe lines larger than 1" shall have 1-inch shock absorbers installed.

2.14 TRAP-SEAL PRIMER DEVICE

A. Flush Valve, Trap-Seal Primer Device:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Precision Plumbing Products Model FVP or comparable product by one of the following:
   a. Jay R. Smith Mfg. Co
   b. MIFAB, Inc
   c. Precision Plumbing Products
   d. Sioux Chief Manufacturing Company, Inc.
   e. WATTS
   f. Zurn Industries, LLC
2. Type: Vacuum breaker trap primer
3. Body: 1-1/2" x 12" 17 GA with compression fitting.
4. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
5. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
6. Finish: Chrome plated.
7. Accessories: Vacuum breaker, chrome plated wall flange, compression fittings.

B. Pressure Drop, Trap-Seal Primer Device:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Precision Plumbing Products Model PR or comparable product by one of the following:
   a. Jay R. Smith Mfg. Co
   b. MIFAB, Inc
   c. Precision Plumbing Products
   d. Sioux Chief Manufacturing Company, Inc.
   e. WATTS
   f. Zurn Industries, LLC
2. Type: Automatic pressure drop activated trap primer valve.
3. Standard: ASSE 1018.
4. Pressure Rating: 125 psig minimum.
5. Body: Brass.
6. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
7. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.

8. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

C. Drainage-Type, Trap-Seal Primer Device:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Precision Plumbing Products Model FVP or comparable product by one of the following:
   a. Jay R. Smith Mfg. Co
   b. MIFAB, Inc
   c. Precision Plumbing Products
   d. Sioux Chief Manufacturing Company, Inc.
   e. WATTS
   f. Zurn Industries, LLC
2. Type: Lavatory P-trap tailpiece trap primer
3. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
4. Size: 1-1/4" minimum. Coordinate size with plumbing fixture requirements.
5. Body: 17 GA cast brass.
6. Finish: Chrome plated.
7. Accessories: Braided 1/2" stainless steel flexible priming hose, slip nuts and washers, chrome plated wall flange, compression fittings.

2.15 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Flex-Hose Co., Inc
2. Flexicraft Industries
3. Hyspan Precision Products, Inc
4. Metraflex Company (The)
5. Proco Products, Inc
6. Unaflex

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
1. Working-Pressure Rating: Minimum 250 psig.
2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
1. Working-Pressure Rating: Minimum 250 psig.
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.16 WATER METERS

A. Displacement-Type Water Meters (NPS 2 and smaller):
1. Basis-of-Design Product: Subject to compliance with requirements, provide Badger Meter Industrial Recordall Disc Series or comparable product by one of the following:

a. ABB
b. Badger Meter, Inc.
c. Sensus

2. Description:
   a. Standard: AWWA C700 and C710.
   b. Pressure Rating: 150-psig working pressure.
   c. Body Design: Nutating disc; totalization meter.
   d. Registration: In gallons.
   e. Case: Lead-free, bronze.
   f. End Connections: Threaded.
3. Transmitter Register: Digital output to remote display.
4. Remote Display: Wall mounted; 10-year battery operated remote electronic meter reading display. Programmable, LCD display.
5. Meter shall be connected to the Building Automation System (BAS) by the BAS provider.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install unions or flanges at all connections to each piece of equipment and on both sides of valves and other in-line devices that require removal for maintenance.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
3. Provide 4" high by 4" wide concrete containment curb with drain below incoming water service reduced-pressure-principle backflow preventers. Interior of containment curb shall be 6" larger than the footprint of the backflow preventer.

C. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

D. Install balancing valves in locations where they can easily be adjusted.

E. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install cabinet-type units recessed in or surface mounted on wall as specified.

F. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve and pump.

G. Install ground hydrants with 1 cu. yd. of crushed gravel around drain hole. Set ground hydrants with box flush with grade.

H. Set freeze-resistant yard hydrants with riser pipe in concrete or pavement. Do not encase canister in concrete.

I. Install signage at all hydrants served from non-potable gray-water systems that reads as follows: "Nonpotable water is utilized for [application name]. CAUTION: NONPOTABLE WATER – DO NOT DRINK."
   1. The words shall be legibly and indelibly printed on a tag or sign constructed of corrosion-resistant waterproof material or shall be indelibly printed on the fixture.
   2. The letters of the words shall be not less than 0.5 inch in height and in colors in contrast to the background on which they are applied.
   3. In addition to the required wordage, the "Do Not Drink" pictograph shall appear on the signage.

J. Install water-hammer arresters in water piping at the end of all branch lines and as indicated on the drawings according to PDI-WH 201. Pipe extensions shall not be used in place of shock absorbers.

K. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

L. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

M. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow. Coordinate 120-v power source with Division 26.

N. Install meters with inlet and outlet shutoff valves. Install bypass around meter with shutoff valve.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Test each reduced-pressure-principle backflow preventer and double-check, backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.3 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 221119

SECTION 221123 - DOMESTIC WATER RECIRCULATION PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. In-line, recirculation pumps.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction materials, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Data: Certificates, for inline, domestic-water pumps, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For inline, domestic-water pumps to include in operation and maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written instructions for handling.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of pumps that fail in materials or workmanship within specified warranty period.
   1. One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: UL 778 for motor-operated water pumps.

C. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

D. Seismic Performance: Inline, domestic-water pumps shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

   1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified."

2.2 HORIZONTALLY MOUNTED, IN-LINE, CIRCULATION PUMPS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Bell & Gossett Series NBF circulator or comparable product by one of the following:
   1. Armstrong Pumps Inc.
   2. Bell & Gossett Domestic Pump; ITT Corporation.
   3. Grundfos Pumps Corp.
   4. TACO Incorporated.

B. Description: Factory-assembled and -tested, in-line, horizontal, permanently lubricated, wet rotor circulation type.

C. Capacities and Characteristics: Refer to drawings.

D. Materials of Construction
   1. Body: Lead-free brinze.
   2. Shaft: Ceramic
   3. Bearings: Carbon, lubricated by the circulating fluid

E. Operating Data
   1. Maximum Working Pressure: 150 psi

2. Maximum Working Temperature: 200°F
3. Minimum Working Temperature: 40°F

F. Motor: Non-overloading at any point on the pump curve with built-in thermal/impedance protection

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.4 CONTROLS

A. Recirculation pumps shall be connected to the Building Automation System for occupied/unoccupied and temperature control.
1. Occupied/Unoccupied Control:
   a. Turns circulator OFF when building is unoccupied.
   b. Turns circulator ON 1-hour (adj) before building is occupied.
2. Temperature Control:
   a. Adjustable set point from 80 to 140°F.
   b. Turns circulator OFF when water temperature reaches set point.
   c. Turns circulator ON when water temperature is 10 degrees F below set point.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for domestic-water-piping system to verify actual locations of piping connections before pump installation.

3.2 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Mount pumps in orientation complying with manufacturer's written instructions.

C. Install continuous-thread hanger rods and vibration isolation of size required to support pump weight.
1. Comply with requirements for vibration isolation devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required.

2. Comply with requirements for hangers and supports specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

D. Install pressure switches in water-supply piping.

E. Install thermostats in hot-water return piping.

3.3 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to pumps, allow space for service and maintenance.

C. Connect domestic-water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.

1. Install flexible connectors adjacent to pumps in suction and discharge piping of the pumps.
   a. Comply with requirements for flexible connectors specified in Section 221116 "Domestic Water Piping."

D. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping.
1. Install pressure gauge at suction of each pump and pressure gauge at discharge of each pump. Install at integral pressure-gauge tappings where provided or install pressure-gauge connectors in suction and discharge piping around pumps.

3.4 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring between temperature controllers and devices.

3.5 IDENTIFICATION

A. Identify system components.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections with the assistance of a factory-authorized service representative.

B. Tests and Inspections:
1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Inline, domestic-water pump will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.7 STARTUP SERVICE

A. Perform startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Set pressure switches, thermostats, timers, and time-delay relays for automatic starting and stopping operation of pumps.
5. Perform the following startup checks for each pump before starting:
   a. Verify bearing lubrication.
   b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
   c. Verify that pump is rotating in the correct direction.
6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
7. Start motor.
8. Open discharge valve slowly.
9. Adjust temperature settings on thermostats.
10. Adjust timer settings.

3.8 ADJUSTING

A. Adjust inline, domestic-water pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust initial temperature set points.

C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 221123

SECTION 221125 - DOMESTIC WATER PACKAGED BOOSTER PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Multiplex, variable-speed booster pumps.

1.3 DEFINITIONS

A. VFC: Variable-frequency controller(s).

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Booster pumps shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the booster pump will remain in place without separation of any parts from the booster pump when subjected to the seismic forces specified and the booster pump will be fully operational after the seismic event."

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, and dimensions of individual components and profiles. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For booster pumps. Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For booster pumps, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For booster pumps to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Comply with ASME B31.9 for piping.

C. UL Compliance for Packaged Pumping Systems:
1. UL 508, "Industrial Control Equipment."
2. UL 508A, "Industrial Control Panels."
3. UL 778, "Motor-Operated Water Pumps."
4. UL 1995, "Heating and Cooling Equipment."

1.9 DELIVERY, STORAGE, AND HANDLING

A. Retain protective coatings and flange's protective covers during storage.

1.10 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of booster pumps that fail in materials or workmanship within specified warranty period.
1. One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MULTIPLEX, VARIABLE-SPEED BOOSTER PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Armstrong Pumps, Inc
2. Bell & Gossett; a Xylem brand
3. Goulds Water Technology; a Xylem brand
4. Grundfos Pumps Corporation U.S.A
5. Hyfab
6. SyncroFlo, Inc.

B. Description: Factory-assembled and -tested, fluid-handling system for domestic water, with pumps, piping, valves, specialties, and controls, and mounted on base. Package shall be arranged in compact design to allow unit to be moved through standard 3'-0" doorway.

C. Pumps:
1. Type: Vertical, multistage as defined in HI 1.1-1.2 and HI 1.3 for in-line, multistage, separately coupled, overhung-impeller, centrifugal pump.
2. Casing: Cast-iron or steel base and stainless-steel chamber.
3. Impeller: Closed, stainless steel or cast bronze; statically and dynamically balanced and keyed to shaft.
4. Shaft: Stainless steel.
5. Seal: Mechanical.
6. Bearing: Water-lubricated sleeve type.

D. Motors: Single speed, with grease-lubricated or pre-greased, permanently shielded, ball-type bearings. Select motors that will not overload through full range of pump performance curve.

E. Piping: Stainless-steel pipe and fittings.

F. Valves:
1. Shutoff Valves NPS 2 and Smaller: Two-piece, full-port ball valve, in each pump's suction and discharge piping and in inlet and outlet headers.
2. Shutoff Valves NPS 2-1/2 and Larger: Lug-type butterfly valve, in each pump's suction and discharge piping and in inlet and outlet headers.
3. Check Valves NPS 2 and Smaller: Silent or swing type in each pump's discharge piping.
4. Check Valves NPS 2-1/2 and Larger: Silent type in each pump's discharge piping.
5. Thermal-Relief Valve: Temperature-and-pressure relief type in pump's discharge header piping.

G. Pressure gauges: Pressure gauges shall be liquid filled, bourdon tube type. Gauges shall be supplied for both the suction and discharge headers.

H. Dielectric Fittings: With insulating material isolating joined dissimilar metals.

I. Package Base: The pressure booster base shall be designed and fabricated to provide proper structural support for all attached equipment, and provide for anchorage to the structure. The

base shall include a rigid structural member for pump and motor support. Main members shall be constructed from heavy weight A-36 structural steel members with reinforcing channels for larger boosters. Steel base shall be painted with machinery enamel.

J. Hydro-pneumatic Tank:
   1. Furnish pre-charged, ASME code and NB stamped for 200 PSI, hydro-pneumatic tank separately for field installation.
   2. Tank shall include a replaceable FDA approved flexible membrane to separate air and water.

K. Control Panel: Factory installed and connected as an integral part of booster pump; automatic for multiple-pump, variable-speed operation, with load control and protection functions.
   1. Control Logic: Solid-state system with transducers, programmable microprocessor, VFC, and other devices in controller.
   2. Motor Controller: NEMA ICS 7.1 variable-frequency, variable torque, solid-state pulse-width modulating type. VFC protective features shall include.
      a. Ground fault
      b. Short Circuit
      c. Motor overload
   3. Main Control Panel: NEMA 250, Type 1. A door-operated non fused main disconnect shall be provided which shall remove power from the entire pressure booster when switched off.
   4. Motor Overload Protection: Each Variable Speed Controller (VFC)/motor shall be protected by a molded case circuit breaker or MSP enclosed in the main control panel.
   5. Starting Devices: Hand-off-automatic selector switch for each pump in cover of control panel, plus pilot device for automatic control.

      a. Duplex, Automatic, Alternating Starter: Switches lead pump to lag main pump and to two-pump operation.
   6. Pump Operation and Sequencing: Pressure-sensing method.
      a. Time Delay: Controls pump on-off operation; adjustable from 1 to 300 seconds.
   7. VFC: Voltage-source, pulse-width, modulating-frequency converter for each pump.
   8. Manual Bypass: Magnetic contactor arranged to transfer to constant-speed operation upon VFC failure.
   9. Suction and discharge pressure transducers.
      a. Pressure transducers shall be utilized for providing all pressure signals for the pump control logic. Pressure switches are not acceptable.
      b. Pressure transducer shall be a solid-state bonded strain gage type with an accuracy of plus/minus 1 %. Transducer shall be constructed of non-ferrous metal suitable for used with domestic water. Pressure transducers constructed of plastic are not acceptable.
      c. Transducer shall be rated for package discharge and suction pressures as shown on submittal.
      d. Pressure transducer shall utilize a Packard type connector to prevent moisture intrusion.
   10. Temperature Sensor
      a. A NTC thermistor or RTD shall be used for sensing the booster pumps' discharge temperatures for temperature limit control logic. Thermostats are not acceptable.

b. The temperature sensor shall be of the immersion type and shall be immersed in water from the pumps' discharge. It shall be sealed off by a reusable compression type fitting allowing easy removal and insertion.

11. Instrumentation: Suction and discharge pressure gages.
12. Lights: Running light for each pump.
13. Alarm Signal Device: Sounds alarm when backup pumps are operating.
    a. Time Delay: Controls alarm operation; adjustable from 1 to 300 seconds, with automatic reset.
14. Thermal-bleed cutoff.
15. Low-suction-pressure cutout.
16. High-suction-pressure cutout.
17. Low-discharge-pressure cutout.
18. High-discharge-pressure cutout.
19. Building Automation System Interface: Provide auxiliary contacts for interface to the building automation system. Building automation systems are specified in Section 230900 "Building Automation and Temperature Control System." Include the following:
    a. On-off status of each pump.
    b. Alarm status.

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.
   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 NFPA 70.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment foundations, and conditions, for compliance with requirements for installation tolerances and other conditions affecting performance of pumps.

B. Examine rough in for piping systems to verify actual locations of piping connections prior to installation.

C. Examine equipment foundations and/or inertia bases for suitable conditions where pumps are to be installed.

D. Correct unsatisfactory conditions prior to installation of pumps.

3.2 INSTALLATION

A. Equipment Mounting:

1. Install booster pumps on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Division 03.
2. Comply with requirements for vibration isolation and seismic control devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment"

B. Support connected domestic-water piping so weight of piping is not supported by booster pumps.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping and Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect domestic-water piping to booster pumps. Install suction and discharge pipe equal to or greater than size of system suction and discharge headers.
1. Install shutoff valves on piping connections to booster-pump suction and discharge headers. Install ball or butterfly valves same size as suction and discharge headers. Comply with requirements for general-duty valves specified in Section 220523 "Valves for Plumbing Piping."
2. Install union, flanged, or grooved-joint connections on suction and discharge headers at connection to domestic-water piping. Comply with requirements for unions and flanges specified in Section 221116 "Domestic Water Piping."
3. Install valved bypass, same size as and between piping, at connections to booster-pump suction and discharge headers. Comply with requirements for domestic-water piping specified in Section 221116 "Domestic Water Piping."
4. Install flexible connectors, same size as piping, on piping connections to booster-pump suction and discharge headers. Comply with requirements for flexible connectors specified in Section 221116 "Domestic Water Piping."
5. Install piping adjacent to booster pumps to allow service and maintenance.

3.4 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:
1. Perform visual and mechanical inspection.
2. Leak Test: After installation, charge booster pump and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start booster pumps to confirm proper motor rotation and booster-pump operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Pumps and controls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ADJUSTING

A. Adjust booster pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust pressure set points.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain booster pumps.

END OF SECTION 221125

SECTION 221316 - SANITARY WASTE AND VENT PIPING AND SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Hub-and-spigot, cast-iron soil pipe and fittings.
2. Hubless, cast-iron soil pipe and fittings.
3. PVC pipe and fittings.
4. Specialty pipe fittings.
5. Encasement for underground metal piping.
6. Floor drains.
7. Trap-seal insert device.
8. Cleanouts.
9. Air-admittance valves.
10. Miscellaneous sanitary drainage piping specialties.
11. Interceptors

B. Contractor shall perform all work within the building and to a point five (5) feet from the building wall, unless otherwise noted.
1. Contractor shall coordinate with site sanitary drainage services provided under another Division.
2. The contractor shall make the final connection of the building sanitary drainage to the site sanitary drainage.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

1.5 QUALITY ASSURANCE

A. Piping, drains and specialty materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary piping specialty components.

1.6 FIELD CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
   1. Notify Owner no fewer than ten days in advance of proposed interruption of sanitary waste service.
   2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
   1. Soil, Waste, and Vent Piping: 10-foot head of water.
   2. Waste, Force-Main Piping: 50 psig.

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. All pipe and fittings shall be from a United States domestic manufacturer.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AB & I Foundry
   2. Charlotte Pipe and Foundry Company
   3. Tyler Pipe

B. Pipe and Fittings:
   1. Marked with CISPI collective trademark and NSF certification mark.

2. Class: ASTM A 74, Service class.

C. Gaskets: ASTM C 564, rubber.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AB & I Foundry
2. Charlotte Pipe and Foundry Company
3. Tyler Pipe

B. Pipe and Fittings:
1. Marked with CISPI collective trademark and NSF certification mark.
2. Standard: ASTM A 888 or CISPI 301.

C. Heavy-Duty, Hubless-Piping Couplings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ANACO-Husky
b. Charlotte Pipe and Foundry Company
c. Ideal-Tridon
d. Tyler Pipe
2. Standard: ASTM C 1540.
3. Description: Corrugated stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.5 PVC PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Charlotte Pipe and Foundry Company
2. Mueller Industries, Inc.
3. National Pipe and Plastic, Inc.
4. North America Pipe Corporation

B. NSF Marking: Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-sewer" for plastic sewer piping.

C. Solid-Wall PVC Pipe: ASTM D 2665; drain, waste, and vent.

D. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

E. Adhesive Primer: ASTM F 656.

F. Solvent Cement: ASTM D 2564.

2.6 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.
3. Shielded, Nonpressure Transition Couplings:
    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        1) Fernco Inc
        2) Mission Rubber Company, LLC; a division of MCP Industries
        3) Plastic Oddities
    b. Standard: ASTM C 1460.
    c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
    d. End Connections: Same size as and compatible with pipes to be joined.

B. Dielectric Fittings
1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:
    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        1) WATTS
        2) Wilkins
        3) Zurn Industries, LLC
    b. Standard: ASSE 1079.
    c. Pressure Rating: 150 psig minimum at 180 deg F.
    d. End Connections: Solder-joint copper alloy and threaded ferrous.
3. Dielectric Flanges:
    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        1) WATTS
        2) Wilkins
        3) Zurn Industries, LLC
    b. Standard: ASSE 1079.
    c. Factory-fabricated, bolted, companion-flange assembly.
    d. Pressure Rating: 150 psig minimum at 180 deg F.
    e. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

2.7 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Standard: ASTM A 674 or AWWA C105/A 21.5.

B. Material: Linear low-density polyethylene film of 0.008-inch minimum thickness.

C. Form: Tube.

D. Color: Black or natural.

2.8 FLOOR DRAINS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Jay R. Smith Mfg. Co
   b. Josam Company
   c. MIFAB, Inc
   d. Sioux Chief Manufacturing...
   e. Wade; a subsidiary of McWane Inc.
   f. WATTS
   g. Zurn Industries, LLC.

B. FD-1 (Finished Floor):
   1. Basis-of-Design Product: Provide Josam 30000-S-ARE-50 or comparable product
   2. Pattern: Floor drain.
   3. Body Material: Cast iron.
   4. Drainage Flange: Required, double.
   5. Flashing Collar: Required, non-puncturing.
   6. Weepholes: Required.
   7. Outlet: Bottom.
   8. Backwater Valve: Not required.
   9. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant epoxy.
   10. Sediment Bucket: Not required.
   11. Strainer: Adjustable
   12. Strainer Material and Finish: Satin nickel-bronze, copper alloy.
   13. Top Shape: Square.
   14. Dimensions of Top or Strainer: 6"x6".
   15. Funnel: Not required.
   16. Features: 1/2" trap-seal primer valve drain connection.

C. FD-2 (Mechanical Rooms):
   1. Basis-of-Design Product: Provide Josam 32100-AE-ARE-50 or comparable product
   2. Pattern: Floor drain.
   3. Body Material: Cast iron.
   4. Drainage Flange: Required, double.
   5. Flashing Collar: Required, non-puncturing.
   6. Weepholes: Required.
   7. Outlet: Bottom.
   8. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant epoxy.
   9. Strainer: Adjustable
   10. Strainer Material and Finish: Satin nickel-bronze, copper alloy.
   11. Grate: Anti-tilting with perimeter drainage slots.
   12. Top Shape: Round.

13. Dimensions of Top or Strainer: 9" diameter.
14. Top Loading Classification: Medium duty.
15. Features: 1/2" trap-seal primer valve drain connection.

2.9 FLOOR SINKS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Jay R. Smith Mfg. Co
   b. Josam Company
   c. MIFAB, Inc
   d. Sioux Chief Manufacturing...
   e. Wade; a subsidiary of McWane Inc.
   f. WATTS
   g. Zurn Industries, LLC.

B. FS-1 (Food Service - Stainless Steel):
   1. Basis-of-Design Product: Provide Zurn Z1751-P-2 or comparable product
   2. Pattern: Floor sink, 8" deep.
   3. Body Material: Type 304 stainless steel.
   4. Outlet: Bottom.
   5. Coating on Interior and Exposed Exterior Surfaces: None.
   6. Sediment Bucket: Not required.
   7. Internal Dome Strainer: Required, stainless steel.
   8. Strainer Material and Finish: Stainless steel.
   9. Top Shape: Square.
   10. Grate: 1/2 grate.
   11. Dimensions of Top or Strainer: 12"x12".
   12. Funnel: Not required.
   13. Features: 1/2" trap-seal primer valve drain connection.

2.10 CLEANOUTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Jay R. Smith Mfg. Co.
   2. Josam Company; Josam Div.
   3. MIFAB, Inc.
   4. Tyler Pipe.
   5. Wade.
   6. WATTS.
   7. Zurn Industries, LLC.

B. Exposed and Above-Ceiling Cleanouts:
   1. Basis-of-Design Product: Provide Josam Series 58900 or comparable product.
   2. Size: Same as connected branch.
   3. Body Material: No-hub, cast-iron soil pipe test tee] as required to match connected piping.

4. Closure: Bronze, countersunk plug.
5. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.

C. Finished Floor Cleanouts:
1. Basis-of-Design Product: Provide Josam Series 55000-1-SQ or comparable product.
2. Size: Same as connected branch.
3. Type: Adjustable cast-iron housing.
4. Body or Ferrule: Cast iron.
5. Outlet Connection: No hub, hub with gasket or inside caulk (based on location).
6. Closure: Internal cast-iron or plastic plug.
7. Adjustable Housing Material: Cast iron with threads.
8. Cover Material and Finish: Scoriated satin nickel-bronze, copper alloy.
9. Frame and Cover Shape: Square.
10. Top Loading Classification: Light Duty.
11. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

D. Unfinished Floor Cleanouts:
1. Basis-of-Design Product: Provide Josam Series 58460A-AE or comparable product.
2. Size: Same as connected branch.
3. Type: Adjustable cast-iron housing.
4. Body: Cast iron.
5. Outlet Connection: No hub, hub with gasket or inside caulk (based on location).
6. Closure: Internal bronze countersunk plug.
7. Cover Material and Finish: Satin nickel-bronze, copper alloy.
8. Cover Shape: Round.
9. Top Loading Classification: Light Duty.
10. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

E. Wall Cleanouts:
1. Basis-of-Design Product: Provide Josam Series 58910-Z or comparable product.
2. Size: Same as connected drainage piping.
3. Body: No-hub, cast-iron soil pipe as required to match connected piping.
4. Closure Plug:
   a. Bronze.
   b. Countersunk head.
   c. Drilled and threaded for cover attachment screw.
   d. Size: Same as, or not more than, one size smaller than cleanout size.
5. Wall Access For Concealed Riser:
   a. Round, flat, nickel-bronze, copper-alloy cover plate with screw.
6. Wall Access for Concealed Riser:
   a. Square, stainless-steel wall-installation frame and cover.

F. Exterior Underground Cleanouts:
1. Basis-of-Design Product: Provide Josam Series 58360 or comparable product.
2. Size: Same as connected branch.
3. Type: Adjustable cast-iron housing.
4. Body or Ferrule: Cast iron.
5. Outlet Connection: Hub with gasket.
6. Closure: Internal bronze countersunk plug.
7. Adjustable Housing Material: Cast iron with threads.

8. Cover Material and Finish: Scoriated satin finish bronze.
9. Frame and Cover Shape: Round.
10. Top Loading Classification: Light Duty.
11. Riser: ASTM A 74, Extra-heavy class, cast-iron drainage pipe fitting and extension to grade.
12. Concrete: Set in twelve (12) inches by twelve (12) inches by eight (8) inches concrete finished flush with grade.

G. Test Tees:
1. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301.
2. Size: Same as connected drainage piping.
3. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or no-hub, cast-iron soil-pipe test tee as required to match connected piping.
4. Closure Plug: Countersunk, brass.
5. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.

2.11 AIR-ADMITTANCE VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Durgo, Inc.
2. Oatey.
3. ProSet Systems Inc.
4. Studor, Inc.

B. Fixture Air-Admittance Valves:
1. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
2. Housing: Plastic.
3. Operation: Mechanical sealing diaphragm.
4. Size: Same as connected fixture or branch vent piping.

C. Stack Air-Admittance Valves:
1. Standard: ASSE 1050 for vent stacks.
2. Housing: Plastic.
3. Operation: Mechanical sealing diaphragm.
4. Size: Same as connected stack vent or vent stack.

D. Wall Box for Air-Admittance Valves:
1. Description: White plastic housing with white plastic grille, made for recessed installation. Include bottom pipe connection and space to contain one air-admittance valve.
2. Size: About 9 inches wide by 8 inches high by 4 inches deep.

2.12 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:
1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.

2. Size: Same as connected waste piping.
   a. NPS 2: 4-inch- minimum water seal.
   b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

B. Air-Gap Fittings:
1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

C. Expansion Joints:
1. Standard: ASME A112.6.4.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

B. Pipe and fittings shall be moved to the trench, carefully lowered and set to line and grade. Pipe shall be laid on the shaped sub-grade. No blocking will be permitted and the bleeding shall be such that it forms a continuous bearing with a minimum width of bearing equal to 0.6 the outside diameter of the pipe for the full length of the pipe, except for that portion at the bell hole.

C. No pipe or fitting shall be installed until sufficient trench has been completely excavated to satisfy the Architect that no unforeseen obstructions of any kind are likely to be encountered. Pipe shall be cut by the Contractor when required without any additional compensation. Special care shall be exercised by the Contractor to prevent damage to any pipe.

D. Before placing in the trench, each pipe or fitting shall be carefully cleaned of any foreign substance which may have collected therein and shall be kept clean at all times thereafter. For this purpose, the open ends of all pipes and fittings in the trench shall be closed to the satisfaction of the Architect before leaving the work for the night and for all holidays or other items of interruption to the work.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install piping to allow application of insulation.

I. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
    a. Straight tees, elbows, and crosses may be used on vent lines.
3. Do not change direction of flow more than 90 degrees.
4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
    a. Reducing size of waste piping in direction of flow is prohibited.

K. Lay buried building waste piping beginning at low point of each system.
1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
3. Maintain swab in piping and pull past each joint as completed.

L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Sanitary Waste Piping: 2 percent downward in direction of flow.

3. Horizontal Kitchen Grease Waste Piping: 2 percent downward in direction of flow.
4. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
1. Install encasement on underground piping in corrosive soils according to ASTM A 674 or AWWA C105/A 21.5.

N. Install underground PVC piping according to ASTM D 2321 (Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications).

O. und Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications).

P. Where soil conditions require the use of pier or piling supported grade beam construction or in filled ground where the soil compaction is less than 95%, underground PVC piping shall be suspended from the structural slab with stainless steel hangers and rods. Installation shall be in accordance with ASTM F2536 (Standard Guide for Installing Plastic DWV Piping Suspended from On-Grade Slabs).

Q. Plumbing Specialties:
1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
2. Install drains in sanitary waste gravity-flow piping.

R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

S. Install sleeves for piping penetrations of interior walls, ceilings, and floors.
1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install sleeve seals for piping penetrations of exterior concrete walls and slabs.
1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install escutcheons for exposed piping penetrations of finished walls, ceilings, and floors.
1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Hubless, Cast-Iron Soil Piping Coupled Joints:

1. Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

C. Plastic, Nonpressure-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. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendices.

D. Joint Restraints and Sway Bracing:
   1. Provide joint restraints and sway bracing for sanitary drainage piping joints to comply with the following conditions:
      a. Provide axial restraint for pipe and fittings 8 inches and larger, upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
      b. Provide rigid sway bracing for pipe and fittings 8 inches and larger, upstream and downstream of all changes in direction 45 degrees and greater.
      c. Provide rigid sway bracing for pipe and fittings 8 inches and larger, upstream and downstream of all changes in direction and branch openings.

3.4 SPECIALTY INSTALLATION

A. Transition Couplings:
   1. Install transition couplings at joints of piping with small differences in ODs.
   2. In Drainage Piping: Nonpressure transition couplings.

B. Dielectric Fittings:
   1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

C. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
   1. Position floor drains for easy access and maintenance.
   2. Set floor drains slightly below elevation of surrounding finished floor to allow positive floor drainage.
   3. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
      a. Maintain integrity of waterproof membranes where penetrated.
   4. Install individual deep-seal traps for floor drains connected to sanitary building drain, unless otherwise indicated.

D. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
   1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   2. Locate at each change in direction of piping greater than 45 degrees.
   3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
   4. Locate at base of each vertical soil and waste stack.

E. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

F. Install trap seal insert devices in accordance with manufacturer's instructions and approved product data submittals.

G. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

H. Install fixture air-admittance valves on fixture drain piping where indicated on Drawings.

I. Install stack air-admittance valves at top of stack vent and vent stack piping where indicated on Drawings.

J. Install air-admittance-valve wall boxes recessed in wall where indicated on Drawings.

K. Install deep-seal traps on floor drains and other indirect waste outlets, unless otherwise noted.

L. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

M. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.

N. Install blocking reinforcement for wall-mounting-type specialties.

O. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

C. Install hangers for metal piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Install hangers for plastic piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

F. Support vertical runs of metal piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

G. Support vertical runs of plastic piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect waste and vent piping to the following:
1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.7 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping.

B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 48 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. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
    a. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure:
    a. Test waste and vent piping except outside leaders on completion of roughing-in.
    b. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
    c. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
    d. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
    a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
    b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
    c. Air pressure must remain constant without introducing additional air throughout period of inspection.
    d. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

C. Reinspection: Piping will be considered defective if it does not pass tests and inspections. Make required corrections and arrange for reinspection.

D. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

E. All new and existing sanitary drainage systems to the point of service connection or termination outside the building footprint for sanitary drainage shall be completely cleared with a plumber's snake and flushed after a building is completed and prior to Substantial Completion.

3.9 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Repair damage to adjacent materials caused by waste and vent piping installation.

E. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
1. If drains are not covered and it is suspected that dirt, debris or trash has entered the drainage system, the interior drainage system shall be professionally cleaned to the Architect's satisfaction and at no expense to the Owner.

3.10 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil, waste and vent piping shall be the following:
   1. Hubless, cast-iron soil pipe and fittings; heavy-duty, hubless-piping couplings; and coupled joints.
   2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

C. Underground, soil, waste, and vent piping shall be the following:
   1. **Solid-wall** PVC pipe, PVC socket fittings, and solvent-cemented joints.
   2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

D. Aboveground kitchen grease waste piping shall be the following:
   1. Hubless, cast-iron soil pipe and fittings; heavy-duty, hubless-piping couplings; and coupled joints.

E. Underground kitchen grease waste piping shall be the following:
   1. Hub and spigot, cast-iron soil pipe and fittings, service class; gaskets; and gasketed joints.

END OF SECTION 221316

SECTION 221413 - STORM DRAINAGE PIPING AND SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Hub-and-spigot, cast-iron soil pipe and fittings.
2. Hubless, cast-iron soil pipe and fittings.
3. Galvanized-steel pipe and fittings.
4. Copper tube and fittings.
5. PVC pipe and fittings.
6. Specialty pipe and fittings.
7. Encasement for underground metal piping.
8. Roof drains.
9. Miscellaneous storm drainage piping specialties.

B. Related Requirements:

1. Section 221316 "Sanitary Waste and Vent Piping and Specialties" for cleanout product data.

C. Roof and overflow drains shall be furnished by plumbing contractor, installed by the plumbing contractor and adjusted by the roofing contractor. Roofing contractor(s) shall be responsible for flashing all roof penetrations thru roof systems to maintain warranties.

D. Contractor shall perform all work within the building and to a point five (5) feet from the building wall, unless otherwise noted.
1. Contractor shall coordinate with site storm drainage services provided under another Division.
2. The contractor shall make the final connection of the building storm drainage to the site storm drainage.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For storm drainage piping, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

1.5 QUALITY ASSURANCE

A. Piping and specialty materials shall bear label, stamp, or other markings of specified testing agency.

1.6 FIELD CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
1. Notify Owner no fewer than ten days in advance of proposed interruption of storm drainage service.
2. Do not proceed with interruption of storm drainage service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
1. Storm Drainage Piping: 10-foot head of water.
2. Storm Drainage, Force-Main Piping: 50 psig.

B. Seismic Performance: Storm drainage piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. All pipe and fittings shall be from a United States domestic manufacturer.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AB & I Foundry
   2. Charlotte Pipe and Foundry Company
   3. Tyler Pipe

B. Pipe and Fittings:
   1. Marked with CISPI collective trademark and NSF certification mark.
   2. Class: ASTM A 74, Service class.

C. Gaskets: ASTM C 564, rubber.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AB & I Foundry
   2. Charlotte Pipe and Foundry Company
   3. Tyler Pipe

B. Pipe and Fittings:
   1. Marked with CISPI collective trademark and NSF certification mark.
   2. Standard: ASTM A 888 or CISPI 301.

C. Heavy-Duty, Hubless-Piping Couplings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ANACO-Husky
      b. Charlotte Pipe and Foundry Company
      c. Ideal-Tridon
      d. Tyler Pipe
   2. Standard: ASTM C 1540.
   3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.5 GALVANIZED-STEEL PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Tubular USA
   2. U.S. Steel
   3. Wheatland Tube Company

B. Pipe: ASTM A 53/A 53M, Type E, Standard Weight class. Include square-cut-grooved or threaded ends matching joining method.

C. Galvanized-Cast-Iron Drainage Fittings: ASME B16.12, threaded.

D. Galvanized-Steel Pipe Pressure Fittings:
   1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Schedule 40, seamless steel pipe. Include ends matching joining method.
   2. Galvanized-Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.

2.6 COPPER TUBE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cambridge-Lee Industries, LLC
   2. Cerro Flow Products, LLC
   3. Mueller Industries, Inc.
   4. Wieland Copper Products, LLC

B. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.

C. Copper Pressure Fittings:
   1. Copper Fittings: ASME B16.18, cast-copper-alloy fittings or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
   2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

D. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.7 PVC PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Charlotte Pipe and Foundry Company
   2. Mueller Industries, Inc.
   3. National Pipe and Plastic, Inc.
   4. North America Pipe Corporation

B. NSF Marking: Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic storm drain and "NSF-sewer" for plastic storm sewer piping.

C. Solid-Wall PVC Pipe: ASTM D 2665; drain, waste, and vent.

D. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

E. Adhesive Primer: ASTM F 656.

F. Solvent Cement: ASTM D 2564.

2.8 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.
3. Shielded, Nonpressure Transition Couplings:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Fernco Inc
      2) Mission Rubber Company, LLC; a division of MCP Industries
      3) Plastic Oddities
   b. Standard: ASTM C 1460.
   c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
   d. End Connections: Same size as and compatible with pipes to be joined.

4. Pressure Transition Couplings:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Cascade Waterworks Mfg. Co
      2) EBAA Iron, Inc.
      3) JCM Industries, Inc
      4) Romac Industries, Inc.
   b. Standard: AWWA C219.
   c. Description: Metal, sleeve-type couplings same size as pipes to be joined, and with pressure rating at least equal to and ends compatible with pipes to be joined.
   d. Center-Sleeve Material: Manufacturer's standard.
   e. Gasket Material: Natural or synthetic rubber.
   f. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings
1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) WATTS
      2) Wilkins
      3) Zurn Industries, LLC
   b. Standard: ASSE 1079.
   c. Pressure Rating: 150 psig minimum at 180 deg F.
   d. End Connections: Solder-joint copper alloy and threaded ferrous.
3. Dielectric Flanges:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1) WATTS
   2) Wilkins
   3) Zurn Industries, LLC
b. Standard: ASSE 1079.
c. Factory-fabricated, bolted, companion-flange assembly.
d. Pressure Rating: 150 psig minimum at 180 deg F.
e. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

2.9 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Standard: ASTM A 674 or AWWA C105/A 21.5.

B. Material: Linear low-density polyethylene film of 0.008-inch minimum thickness.

C. Form: Tube.

D. Color: Black or natural.

2.10 ROOF DRAINS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Jay R. Smith Mfg. Co.
   2. Josam Company; Josam Div.
   3. MIFAB, Inc.
   4. WATTS.
   5. Zurn Industries, LLC.

B. RD-1: Large-Sump, General-Purpose Roof Drains:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Josam 21500-AE or comparable product.
   2. Standard: ASME A112.6.4.
   3. Body Material: Cast iron.
   4. Dimension of Body: Nominal 14-to 16-inch diameter.
   5. Deck Clamp Assembly and Drain Receiver: Required
   6. Combination Clamp Ring and Gravel Stop: Required.
   7. Outlet: Bottom.
   8. Outlet Type: No hub.
   9. Extension Collars: Adjustable
   10. Underdeck Clamp: Required.
   11. Dome Material: Cast iron.
   12. Wire Mesh: Not required.
   13. Internal Water Dam: Not required.

C. RD-2: Composition Deck Roof Drains:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Josam 24040 or comparable product.
2. Body Material: Cast iron.
3. Dimension of Body: Nominal 14-to 16-inch diameter.
4. Deck Clamp Assembly and Drain Receiver: Required
5. Combination Clamp Ring and Gravel Stop: Required.
6. Outlet: Bottom.
7. Outlet Type: No hub.
8. Extension Collars: Adjustable
9. Underdeck Clamp: Required.
10. Wire Mesh: Not required.
11. Internal Water Dam: Not required.

2.11 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Jay R. Smith Mfg. Co.
   2. Josam Company; Josam Div.
   3. MIFAB, Inc.
   4. WATTS.
   5. Zurn Industries, LLC.

B. Downspout Nozzles:
   1. Basis-of-Design Product: Provide Zurn Z199 or comparable product.
   2. Description: Cast nickel bronze body with threaded inlet and bronze wall flange with mounting holes.
   3. Size: Same as connected conductor.

2.12 CLEANOUTS

A. Refer to Section 221316 "Sanitary Waste and Vent Piping and Specialties" for cleanout product data.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

B. Pipe and fittings shall be moved to the trench, carefully lowered and set to line and grade. Pipe shall be laid on the shaped sub-grade. No blocking will be permitted and the bleeding shall be such that it forms a continuous bearing with a minimum width of bearing equal to 0.6 the outside diameter of the pipe for the full length of the pipe, except for that portion at the bell hole.

C. No pipe or fitting shall be installed until sufficient trench has been completely excavated to satisfy the Architect that no unforeseen obstructions of any kind are likely to be encountered. Pipe shall be cut by the Contractor when required without any additional compensation. Special care shall be exercised by the Contractor to prevent damage to any pipe.

D. Before placing in the trench, each pipe or fitting shall be carefully cleaned of any foreign substance which may have collected therein and shall be kept clean at all times thereafter. For this purpose, the open ends of all pipes and fittings in the trench shall be closed to the satisfaction of the Architect before leaving the work for the night and for all holidays or other items of interruption to the work.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
   1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
   2. Install piping as indicated unless deviations from layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install piping to allow application of insulation.

I. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

J. Make changes in direction for piping using appropriate branches, bends, and long-sweep bends.
   1. Do not change direction of flow more than 90 degrees.
   2. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
      a. Reducing size of drainage piping in direction of flow is prohibited.

K. Lay buried building piping beginning at low point of each system.

1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
3. Maintain swab in piping and pull past each joint as completed.

L. Install piping at the following minimum slopes unless otherwise indicated:
1. Building Storm Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Storm Drainage Piping: 2 percent downward in direction of flow.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
1. Install encasement on underground piping in corrosive soils according to ASTM A 674 or AWWA C105/A 21.5.

N. Install underground PVC piping according to ASTM D 2321 (Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications).

O. Where soil conditions require the use of pier or piling supported grade beam construction or in filled ground where the soil compaction is less than 95%, underground PVC piping shall be suspended from the structural slab with stainless steel hangers and rods. Installation shall be in accordance with ASTM F2536 (Standard Guide for Installing Plastic DWV Piping Suspended from On-Grade Slabs).

P. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
1. Install encasement on piping in corrosive soils according to ASTM A 674 or AWWA C105/A 21.5.

Q. Install force mains at elevations indicated.

R. Plumbing Specialties:
1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping.
   a. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.

S. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

T. Install sleeves for piping penetrations of interior walls, ceilings, and floors.
1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install sleeve seals for piping penetrations of exterior concrete walls and slabs.
1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install escutcheons for exposed piping penetrations of finished walls, ceilings, and floors.

1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 SPECIALY INSTALLATION

A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
   1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
   2. Install expansion joints, if indicated, in roof drain outlets.
   3. Position roof drains for easy access and maintenance.

B. Install downspout boots at grade with top 12 inches above grade. Secure to building wall.

C. Install downspout nozzles at exposed bottom of conductors where they spill onto grade.

D. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:
   1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
   3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
   4. Locate cleanouts at base of each vertical storm piping conductor.

E. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

F. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

G. Install test tees in vertical conductors and near floor.

H. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

I. Install through-penetration firestop assemblies for penetrations of fire- and smoke-rated assemblies.

3.4 JOINT CONSTRUCTION

A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Hubless, Cast-Iron Soil Piping Coupled Joints:
   1. Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.

1. Cut threads full and clean using sharp dies.
2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
    a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
    b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
    c. Do not use pipe sections that have cracked or open welds.

D. Join copper tube and fittings with soldered joints according to ASTM B 828 procedure. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

E. Plastic, Nonpressure-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. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendices.

F. Joint Restraints and Sway Bracing:
1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
    a. Provide axial restraint for pipe and fittings 8 inches and larger, upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
    b. Provide rigid sway bracing for pipe and fittings 8 inches and larger, upstream and downstream of all changes in direction 45 degrees and greater.
    c. Provide rigid sway bracing for pipe and fittings 8 inches and larger, upstream and downstream of all changes in direction and branch openings.

3.5 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:
1. Install transition couplings at joints of piping with small differences in ODs.
2. In Drainage Piping: Nonpressure transition couplings.
3. In Aboveground Force-Main Piping: Fitting-type transition couplings.
4. In Underground Force-Main Piping:
    a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
    b. NPS 2 and Larger: Pressure transition couplings.

B. Dielectric Fittings:
1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

C. Install hangers for metal piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Install hangers for plastic piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

F. Support vertical runs of metal piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

G. Support vertical runs of plastic piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.
1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.

D. Connect force-main piping to the following:
1. Sump Pumps: To sump pump discharge.

E. Where installing piping adjacent to equipment, allow space for service and maintenance.

3.8 IDENTIFICATION

A. Identify exposed storm drainage piping.

B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 FLASHING INSTALLATION

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

3.10 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 48 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.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
      a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved.
      a. Expose work that was covered or concealed before it was tested.
   3. Test Procedure:
      a. Test storm drainage piping, except outside leaders, on completion of roughing-in.
      b. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
      c. From 15 minutes before inspection starts until completion of inspection, water level must not drop.
      d. 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.

D. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
      a. Expose work that was covered or concealed before it was tested.
   2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.
      a. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

E. Reinspection: Piping will be considered defective if it does not pass tests and inspections. Make required corrections and arrange for reinspection.

F. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

G. All new and existing storm drain systems to the point of service connection or termination outside the building footprint for storm drainage shall be completely cleared with a plumber's snake and flushed after a building is completed and prior to Substantial Completion..

3.11 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

C. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.12 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground storm drainage piping shall be the following:
1. Hubless, cast-iron soil pipe and fittings; heavy-duty, hubless-piping couplings; and coupled joints.
2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

C. Underground storm drainage piping shall be the following:
1. **Solid-wall** PVC pipe, PVC socket fittings, and solvent-cemented joints.
2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

D. Aboveground storm drainage force mains shall be the following:
1. Galvanized-steel pipe, pressure fittings, and threaded joints.
2. Fitting-type transition couplings if dissimilar pipe materials.

END OF SECTION 221413

SECTION 221429 - SUMP PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Submersible oil-sensing sump pumps.

B. Related Requirements:

1. Section 221413 "Storm Drainage Piping and Specialties" for sump pump forced main piping.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:
1. Include mounting and attachment details.
2. Include details of equipment assemblies.
3. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with manufacturer's written instructions for handling.

1.6 WARRANTY

A. Pump and oil monitoring control system shall have a 3-year warranty against failure due to defective materials or workmanship.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

2.2 SUBMERSIBLE SUMP PUMPS

A. Submersible, Fixed-Position, Single-Seal Oil-Sensing Sump Pumps:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Stancor Multi-Option Oil Minder SE or comparable product by one of the following:
      a. Bell & Gossett; a Xylem brand.
      b. Goulds Water Technology; a Xylem brand
      c. Grundfos Pumps Corp
      d. Liberty Pumps
      e. Little Giant Pump Co
      f. Stancor, Inc
      g. Weil Pump Company, Inc
      h. Zoeller Company
   2. Description: Factory-assembled and -tested oil-sensing sump-pump unit built and tested to meet UL 778 standards and shall include thermal overload protection.
      a. The control panel, pump, on/off float, high water alarm float, wiring, J-Box and oil sensor probe shall be factory assembled as a complete assembly, ready to use system and shall be tested, approved and labeled, for the intended purpose as a system, and certified by a nationally recognized independent testing laboratory such as ENTELA.
      b. The pump and oil sensor technology control system must comply with ASME A17.1.
   3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.
   4. Pump Casing: Cast iron, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection. Exposed fasteners shall be AISI Type 316 stainless steel.
   5. Impeller: Statically and dynamically balanced, semi-open non-clogging vortex design for clear wastewater handling, and keyed and secured to shaft.
   6. Pump Volute: Single piece design with vertical discharge.
   7. Pump and Motor Shaft: Stainless steel, with factory-sealed, permanently lubricated, greased ball bearings.
   8. Seal: Mechanical.

9. Motor Housing: Type 304 stainless steel.
10. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
    a. Motor Housing Fluid: Air-filled, water-tight.
11. Discharge Connection: 2-inch.
12. Controls:
    a. Enclosure: NEMA 250, Type 4X; wall mounted, with wiring terminal strip for field wiring to the junction box in the hoistway.
    b. Oil Sensitivity Switch: Field adjustable switch with variable oil sensitivity settings, for indicating oil present, having an adjustable range of 1 to 10, factory set at #5 oil sensitivity and shall be capable of sensing and alarming emulsified oil or solid oil.
    c. Motor Overload: Separate over-current relay and field adjustable motor overload having a range of 5 to 15 amps, factory set at 8 amps.
    d. Combination manual reset/push to test switch for motor overload with both automatic, manual reset and control diagnostics. The control system must be factory set for automatic overload restart.
    e. Oil Sensor Level Probe: Factory installed, hermetically sealed, heavy duty, stainless steel, set no higher than 4" from the bottom of the pit.
    f. Main Float Switch: Factory installed, shall automatically start pump on a level increase in the sump pit fluid level. When the water or fluid level drops below the oil sensor probe tip the pump will automatically turn off.
    g. High Water Alarm: High water alarm float switch shall act as a redundant pump run (on) float in the event of the main float switch failure.
    h. Remediation Provision: Oil-minder by-pass switch mounted on the control panel to allow the control panel to be manually overridden allowing the sump pump to start.
    i. Provide a solid state push/hold to test button to perform all pump, alarm, led lights, remote contacts and control diagnostic tests.
    j. Junction Box: Provide a NEMA 6P J-Box with a back plate, din rail, screw down terminals and terminal markers.
13. Electrical:
    a. Control enclosure shall be provided with power cord and molded ground plug.
    b. Wiring from the control panel to the J-Box is to be hard wired with multi-pin connector and manufacturer's cord in lengths as required. Cord shall be installed in conduit.
    c. Wiring from the J-Box to the pump pit (pump cable, probe cable, high liquid alarm cable, and pump "on" float cable) is to be hard wired with manufacturer's cord (maximum 16 ft.).
    d. Wiring shall be in accordance with manufacturer's written instructions.
14. Control-Interface Features:
    a. Remote Alarm Contacts: For remote alarm interface.
    b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
        1) On-off status of pump.
        2) Oil detected.
        3) High water alarm.
        4) High amperage/motor overload alert.
        5) Loss of Power.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

3.2 INSTALLATION

A. Pump Installation Standards: Comply with HI 1.4 for installation of sump pumps.

3.3 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
1. Perform each visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Pumps and controls will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.

3.6 ADJUSTING

A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust control set points.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 221429

SECTION 224200 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Plumbing fixtures.
2. Supports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide all plumbing fixtures indicated on the contract drawings and as specified herein.

B. The Contractor shall provide metal supports necessary to adequately and substantially hang and set all fixtures subject to the approval of the Architect. No wood grounds, wood plugs, or expansion bolts shall be permitted for fixture support. Provide floor mounted carriers where specified below and as required to hang fixtures.

C. NSF Standard: Comply with NSF standards for materials that will be in contact with potable water.

D. Unless specified to be provided integral to the faucet, all handwashing fixtures (lavatories, hand sinks) shall be provided with factory calibrated mixing valve which conforms to ASSE 1070 not to exceed 110°.

2.2 MANUFACTURERS

A. Water Closet Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Standard America
2. Kohler Co
3. Sloan Valve Company
4. TOTO USA, INC
5. Zurn Industries, LLC

B. Urinal Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Standard America
2. Kohler Co
3. Sloan Valve Company
4. TOTO USA, INC
5. Zurn Industries, LLC

C. Flushometer Valve Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Sloan Valve Company
2. TOTO USA, INC
3. Zurn Industries, LLC

D. Toilet Seat Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Standard America.
2. Bemis Manufacturing Company.
3. Church Seats.
4. Kohler Co.
5. Toto USA, Inc.

E. Lavatory and Sink Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Standard America
2. Kohler Co
3. TOTO USA, INC

F. Stainless Steel Sink Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eagle Group; Foodservice Equipment Division.
2. Elkay Manufacturing Co.
3. Griffin Products, Inc.
4. Just Manufacturing
5. Kohler Co

G. Faucet Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Standard America.
2. Chicago Faucets.
3. Eljer
4. Kohler Co.
5. Sloan Valve Company.
6. T & S Brass and Bronze Works, Inc.
7. WaterSaver

H. Drinking Fountain and Water Cooler Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Elkay Manufacturing Co
2. Filtrine Manufacturing Company
3. Halsey Taylor
4. Haws Corporation
5. Oasis International; a Lynn Tilton company

I. Water Outlet Box Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Halsey Taylor
2. IPS Corporation/Guy Gray
3. Oatey

J. Drain Accessory (P-Traps, Strainers, Angle Stops, Escutcheons and Supplies) Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Brasscraft
2. Chicago
3. Dearborn
4. EBC
5. McGuire
6. Zurn

2.3 WATER CLOSETS

A. P-1 Water Closets: Floor mounted, bottom outlet, top spud.
1. Fixture combination:
   a. Sloan WETS-2000.1304
2. Fixture:
   a. Sloan ST-2009, vitreous china, siphon jet, elongated, 1.28 gallons per flush, NPS 1-1/2 inlet, white with anti-microbial ceramic glaze.
3. Flushometer Valve:
   a. Sloan Royal 111-1.28 exposed, recessed sensor activated, hard-wired, diaphragm type, 1.28 gallons per flush, polished chrome finish, courtesy overide.
4. Toilet Seat:
   a. Church No. 9500SSCT commercial heavy-duty, elongated rim, open front, less cover, white, stainless steel check-hinge with gasket. Shall comply with American Nation Standard Z124.5.
5. Remarks:

a. Contractor shall verify and coordinate rough-in locations.

B. P-1a Water Closets: Floor mounted, bottom outlet, top spud, ADA.
1. Fixture combination:
a. Sloan WETS-2020.1304
2. Fixture:
a. Sloan ST-2029, vitreous china, siphon jet, elongated, 1.28 gallons per flush, NPS 1-1/2 inlet, white with anti-microbial ceramic glaze.
3. Flushometer Valve:
a. Sloan Royal 111-1.28 exposed, recessed sensor activated, hard-wired, diaphragm type, 1.28 gallons per flush, polished chrome finish, courtesy overide.
4. Toilet Seat:
a. Church No. 9500SSCT commercial heavy-duty, elongated rim, open front, less cover, white, stainless steel check-hinge with gasket. Shall comply with American Nation Standard Z124.5.
5. Remarks:
a. Contractor shall verify and coordinate rough-in locations.
b. Installation shall meet the American with Disabilities Act guidelines and ANSI A117.1 Accessible and Usable Buildings and Facilities.
c. Plumb trap primer connection from flush valve to floor drain.

2.4 URINALS

A. P-2 Urinals: Wall mounted, back outlet, top spud.
1. Fixture combination:
a. Sloan WEUS-1000.1304.
2. Fixture:
a. Sloan SU-1009, vitreous china, washout flush, 0.125 gallons per flush, NPS 3/4 inlet, white with anti-microbial ceramic glaze.
3. Flushometer Valve:
a. Sloan Royal 186ESS, exposed, recessed sensor activated, hard-wired, diaphragm type, 1.28 gallons per flush, polished chrome finish, courtesy overide.
4. Strainer or Trapway:
a. Manufacturer's standard strainer with integral trap.
5. Support:
a. Josam 17550 Series floor mounted urinal carrier. Include additional extension coupling, faceplate, and feet as required for installation in pipe space.
6. Remarks:
a. Contractor shall verify and coordinate rough-in locations. Modern contoured design.
b. Installation shall meet the American with Disabilities Act guidelines and ANSI A117.1 Accessible and Usable Buildings and Facilities.

2.5 LAVATORIES

A. P-3 Lavatories: Oval, self-rimming, under mounted.
1. Fixture:

a. Sloan SS-3021-STG, vitreous china, oval, 22 by 16 inches, one hole faucet punching, front overflow, white.

2. Faucet:
   a. Sloan Optima EAF-225, automatic-type, hard wired, electronic-sensor-operated, nonmixing, solid-brass valve, single hole, 0.5 gpm, rigid spout, laminar flow outlet, polished chrome finish with an integral ASSE 1070 valve. Time out setting for faucet shall be set for 12 seconds.
3. Strainer:
   a. McGuire 155-WC cast brass chrome plated offset wheelchair strainer with polished chrome cast brass elbow, 17 gauge 1-1/4 inch seamless brass offset tailpiece, heavy rubber basin washer and fiber friction washer. Offset lavatory strainer shall be in compliance with CSA or other recognized testing authority and bear both manufacturer and testing mark.
4. Trap:
   a. McGuire 8902C cast brass chrome plated 1-1/4" x 1-1/2" P-trap with cleanout with 17 gauge tubular wall bend, cast brass slip nuts. Trap shall be in compliance with CSA and bear both manufacturer and testing mark.
5. Supplies and Stops:
   a. Chicago Faucets 1017-ABCP angle stop fitting with supply tube and loose key. 2-1/4" tee handle, tapered square broach, compression cartridge, 1/2 NPT female thread inlet, 3/8 NPT female compression outlet.
6. Remarks:
   a. Installation shall meet the American with Disabilities Act guidelines and ANSI A117.1 Accessible and Usable Buildings and Facilities.
   b. Contractor shall verify and coordinate rough-in locations.

2.6 SINKS

A. P-4 Hand Sink: Stainless steel, self-rimming, undermount
1. Fixture:
   a. Just Manufacturing US-1821-A undermount single-bowl sink, seamless 18 gauge, type 304, 18-8 stainless steel. Polished top and interior surfaces, highlighted bowl rim. Smooth, fully coated underside. 7 1/2" deep, center drain punched for 3-½" drain opening.
2. Faucet:
   a. Chicago Faucets No. 201-AGN8AE3-319AB, concealed deck-mount faucet with 8" fixed centers, rigid/swing gooseneck spout, 8" center-to-center, 2.2 GPM pressure compensating, non-aerating, laminar outlet, 4" vandal-proof wristblade handles, rebuildable compression cartridge.
3. Strainer:
   a. McGuire 1151-WC cast brass chrome plated offset basket strainer with polished chrome cast brass elbow, 17 gauge 1-1/2 inch seamless brass offset tailpiece, heavy rubber basin washer and fiber friction washer. Offset basket strainer shall be in compliance with CSA or other recognized testing authority and bear both manufacturer and testing mark.
4. Trap:
   a. McGuire 8912C cast brass chrome plated 1-1/2" x 1-1/2" P-trap with cleanout with 17 gauge tubular wall bend, cast brass slip nuts. Trap shall be in compliance with CSA and bear both manufacturer and testing mark.

5. Supplies and Stops:
   a. Chicago Faucets 1017-ABCP angle stop fitting with supply tube and loose key. 2-1/4" tee handle, tapered square broach, compression cartridge, 1/2 NPT female thread inlet, 3/8 NPT female compression outlet.
6. Remarks:
   a. Installation shall meet the American with Disabilities Act guidelines and ANSI A117.1 Accessible and Usable Buildings and Facilities.
   b. Contractor shall verify and coordinate rough-in locations.

B. P-4a Hand Sink: Stainless steel, self-rimming, undermount (Basin Only)
1. Fixture:
   a. Just Manufacturing US-1821-A undermount single-bowl sink, seamless 18 gauge, type 304, 18-8 stainless steel. Polished top and interior surfaces, highlighted bowl rim. Smooth, fully coated underside. 7 1/2" deep, center drain punched for 3-½" drain opening.

C. P-5 Mop Sink: Floor mounted, terrazzo.
1. Fixture:
   a. Fiat Model MSB500, one piece, 36"x24" precast, ground and polished terrazzo with stainless steel caps.
2. Faucet:
   a. Chicago Faucets No. 897-CP, wall mounted sink faucet for hot and cold water with 7-5/8" - 8-3/8" adjustable centers. Chrome plated, vacuum breaker spout with pail hook and wall brace. 2-3/8" metal, vandal-proof, lever handles with sixteen-point, tapered broach and secured blue and red index buttons. Rebuildable compression cartridge, opens and closes 90°, closes with water pressure, features square, tapered stem. Adjustable supply arms shall include 1/2" NPT female union nut. 3/4" male hose thread outlet. Integral stop valves for servicing the faucet.
3. Strainer:
   a. Fiat 1453-BB flat type stainless steel.
4. Remarks:
   a. Fiat E-77-AA vinyl bumper guard, Fiat 889-CC mop hanger and stainless steel wall guards.
   b. Install terrazzo mop basin on 1/2" layer of mortar per manufacturer's instructions.
   c. Contractor shall verify and coordinate rough-in locations.

2.7 DRINKING FOUNTAIN

A. P-6 Electric Water Cooler: Wall mounted, bi-level, refrigerated, bottle filler.
1. Fixture:
   a. Elkay LZSTL8WSLK bottle filling station & bi-level ADA cooler, filtered 8 GPH, light gray granite finish with matching cane apron, 8.0 GPH of 50F drinking water, based on 80F inlet water and 90F ambient. Features shall include hands-free, visual LED filter status monitor, water filter, green ticker, laminar flow, antimicrobial, drain, flexiguard (pliable polyester elastomer) laminar flow safety bubblers, electronic bottle filler sensor with electronic front and side bubbler pushbar activation. Unit shall be lead-free design which is certified to NSF/ANSI 61 & 372 and meet Federal and State low-lead requirements.
2. Carrier:

a. In-wall floor mounted carrier mounting system.

3. Remarks:
   a. Installation shall meet the American with Disabilities Act guidelines and ANSI A117.1 Accessible and Usable Buildings and Facilities.
   b. Contractor shall verify and coordinate rough-in locations.

2.8 EMERGENCY FIXTURES

A. P-12 Emergency Eyewash: Pedestal mounted, swing down
   1. Fixture:
      a. Guardian G1825 free standing, pedestal mounted eyewash with stainless steel bowl and two spray heads with flip-top dust covers, in-line strainer.
   2. Emergency Thermostatic Mixing Valve:
      a. Bradley Navigator EFX8 Model S19-2000, minimum flushing fluid of 0.4 gpm @ 30 psi.
   3. Remarks:
      a. Installation shall meet the American with Disabilities Act guidelines and ANSI A117.1 Accessible and Usable Buildings and Facilities.
      b. Provide cane appron.
      c. Contractor shall verify and coordinate rough-in locations.

2.9 WATER OUTLET BOXES

A. P-14 Ice Maker Outlet Box: Recessed.
   1. Fixture:
      a. IPS Guy Gray Model MIB1HAAB water outlet box, 20 gauge box and 20 gauge faceplate, white powder coat on cold rolled steel finish, 1/4 turn ball valve with 1/2" sweat connection and hammer arrester.
   2. Remark:
      a. Contractor shall verify and coordinate rough-in locations.

B. P-15 Dishwasher Outlet Box: Recessed.
   1. Fixture:
      a. IPS Guy Gray Model MDWB1AB water outlet box, 20 gauge box and 20 gauge faceplate, white powder coat on cold rolled steel finish, 1/4 turn ball valve with 1/2" sweat connection and hammer arrester.
   2. Remark:
      a. Contractor shall verify and coordinate rough-in locations.

2.10 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls and floors for suitable conditions where fixtures will be installed.

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

3.2 FIXTURE INSTALLATION

A. Water-Closets:
   1. Water-Closet Installation:
      a. Install level and plumb according to roughing-in drawings.
      b. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
      c. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.
   2. Support Installation:
      a. Install supports, affixed to building substrate, for wall-hung water closets.
      b. Use carrier supports with waste-fitting assembly and seal.
      c. Install floor-mounted, back-outlet water closets attached to building floor substrate, onto waste-fitting seals; and attach to support.
      d. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.
   3. Flushometer Valve Installation:
      a. Install flushometer-valve, water-supply fitting on each supply to each water closet.
      b. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
      c. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
      d. Install actuators in locations that are easy for people with disabilities to reach, with handle mounted on accessible side of fixture.
      e. Provide offset flush connection as required to coordinate with wall mounted grab bars to all ADA water closets with flush valves.
   4. Install toilet seats on water closets.

B. Urinals:
   1. Urinal Installation:
      a. Install urinals level and plumb according to roughing-in drawings.
      b. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
      c. Install wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.

d. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.
e. Install trap-seal liquid in waterless urinals.

2. Support Installation:
   a. Install supports, affixed to building substrate, for wall-hung urinals.
   b. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
   c. Use carriers without waste fitting for urinals with tubular waste piping.
   d. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.
3. Flushometer-Valve Installation:
   a. Install flushometer-valve water-supply fitting on each supply to each urinal.
   b. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
   c. Install lever-handle flushometer valves for accessible urinals with handle mounted on accessible side of fixture.

C. Lavatories:
1. Install lavatories level and plumb according to roughing-in drawings.
2. Install supports, affixed to building substrate, for wall-mounted lavatories.
3. All faucet handles, where possible, shall have color coded "indexes" identifying the service used.
4. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.
5. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220700 "Plumbing Insulation."

D. Sinks
1. Install sinks level and plumb according to roughing-in drawings.
2. Install supports, affixed to building substrate, for wall-hung sinks.
3. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.
4. Set floor-mounted sinks in leveling bed of cement grout.
5. Install water-supply piping with stop on each supply to each sink faucet.
   a. Install stops in locations where they can be easily reached for operation.
   b. Install check valves on water-supply piping serving mop sink faucets.
6. All faucet handles, where possible, shall have color coded "indexes" identifying the service used.
7. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220700 "Plumbing Insulation."

E. Drinking Fountains:
1. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
2. Install recessed drinking fountains secured to wood blocking in wall construction.
3. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
4. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball valve. Install valves in locations where they can be easily reached for operation.

5. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

F. Emergency Fixtures:
1. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.
2. Install fixtures level and plumb.
3. Fasten fixtures to substrate.
4. Install shutoff valves in water-supply piping to fixtures. Use locking ball valve if specific type valve is not indicated. Install valves locked in open position. Install valves in locations where they can easily be reached for operation.
5. Install dielectric fitting in supply piping to emergency equipment if piping and equipment connections are made of different metals.
6. Install trap and waste piping on drain outlet of emergency equipment receptors that are indicated to be directly connected to drainage system.
7. Install indirect waste piping on drain outlet of emergency equipment receptors that are indicated to be indirectly connected to drainage system.

G. Water Outlet Boxes:
1. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs.

H. Wall Flange and Escutcheon Installation:
1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

I. Joint Sealing:
1. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to fixture color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

J. Confirm operation of all electronic-sensor mechanisms. If hard-wired through transformers, test operation of electronic-sensor mechanisms prior to installing back-up batteries

K. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.3 CONNECTIONS

A. Connect fixtures with water supplies and soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to fixtures, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust fixtures and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

C. Adjust detection range and flow duration for all electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. Clean fixtures and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed fixtures and fittings.

C. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224200

SECTION 230500 - COMMON WORK RESULTS FOR MECHANICAL

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 describes the common work requirements for the mechanical work included in Division 23 and applies to all sections of Division 23.

B. Related Sections:
   1. Section 013150 "Coordination Drawings" for coordination drawing requirements.

1.3 SUSTAINABLE DESIGN REQUIREMENTS – GREEN GLOBES

A. The Owner is pursuing Green Building Initiative (GBI) Green Globes for New Construction (NC) Certification.

B. Submit documentation to GBI-authorized Assessor and respond to questions and requests from GBI-authorized Assessor about Green Globes credits that are the responsibility of Contractor, that depend on product selection or product qualities, or that depend on Contractor's procedures until GBI-authorized Assessor has made its determination on Project's Green Globes certification application.
   1. Document correspondence with GBI-authorized Assessor as informational submittals.

C. Refer to the Division 1 sustainable design requirements for additional information.

1.4 COMMISSIONING

A. The Owner is pursuing Green Building Initiative (GBI) Green Globes for New Construction (NC) Certification. The scope of the commissioning effort is that which is required to facilitate fulfilling Fundamental Commissioning of the Building Energy Systems and Enhanced Commissioning.

B. All building energy-related systems shall be commissioned in order to verify and ensure that fundamental building elements and systems are installed, constructed, calibrated to operate, and perform according to the Owner's Project Requirements, Basis of Design, and Construction Documents.

C. Refer to the Divisions 1 and 23 commissioning specifications for additional information.

1.5 DEFINITIONS

A. Following are definitions of terms and expressions used in the Mechanical and Electrical Sections:
   1. Provide: Furnish and install
   2. Directed: Directed by the Architect or Engineer
   3. Indicated: Indicated in Contract Documents
   4. Concealed: Hidden from normal sight; includes items within furred spaces, pipe and duct shafts, above suspended ceilings and within return air plenums.
   5. Exposed: Non-concealed - Work within Equipment Rooms shall be considered exposed.
   6. Exterior: Items being or situated outside. Items located within a crawl space shall be considered exterior.
   7. Conditioned: Heated or cooled space, or both, within a building and, where required, provided with humidification or dehumidification means, so as to be capable of maintaining a space condition falling within the comfort envelope set forth in ASHRAE 55.
   8. Piping: Includes pipes, fittings, valves, hangers, and accessories comprising a system.
   9. Ductwork: Includes ducts, fittings, housings, dampers, hangers, air devices, and accessories comprising a system.
   10. Architect: Principal design professional for the project. In certain types of projects, the principal design professional may be an engineer rather than an architect. For such projects, within the bounds of these specifications, where the term "architect" is used, it may refer instead to the engineer.

1.6 CODES, REGULATIONS, AND PERMITS:

A. References to codes, standards, specifications, and regulations apply to the latest edition adopted by the jurisdiction where the project is located.

B. All materials furnished and all work installed shall comply with the applicable rules, regulations, and recommendations of the following bodies:
   1. International Building Code
   2. International Existing Building Code
   3. International Mechanical Code
   4. International Plumbing Code
   5. International Fire Code
   6. International Energy Code
   7. National Electric Code
   8. National Fire Protection Association Standards
   9. State Fire Marshal Regulations
   10. Local Fire Marshal Regulations
   11. ASHRAE Standards and Handbooks (Latest Editions)
   12. Local Health Department
   13. State Health Department
   14. Local Utility Companies
   15. Underwriters Laboratories
   16. Owner's Insurance Underwriter Standards
   17. Environmental Protection Agency

C. Give all necessary notices, obtain all permits, and pay all fees and other costs, including those for utility connections or extensions in connection with the work. File all necessary plans, prepare all documents, and obtain all necessary approvals of all governmental departments having jurisdiction. Obtain all required certificates of inspection and deliver same to the Architect before request for acceptance and final payment for the work.

1.7 EQUIPMENT LIST

A. Provide a spreadsheet list of all equipment provided with the drawing tag number or designation, name, manufacturer, model number, serial number and full electrical characteristics.

B. This list shall be provided to the TAB agent, Commissioning Agent, BAS providers and to the Owner prior to beginning TAB work and as soon after all equipment is received on site.

1.8 EQUIPMENT START-UP AND INITIAL OPERATION

A. No equipment shall be operated, for testing or trial use, before full compliance with the equipment manufacturers' specifications and instructions for the lubrication, alignment, direction of rotation, balance, and other applicable considerations.

B. Particular care shall be taken to see that all equipment is completely assembled, properly lubricated, and all grease and oil cases and reservoirs have been filled to the correct level with the recommended lubricants.

C. It is the Contractor's responsibility to place each item of equipment, installed by him, in operating condition. This responsibility includes all auxiliaries, piping, wiring, etc., the start up of each unit, and a check of its performance.

1.9 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Refer to Section 017900 "Demonstration and Training" for additional information.

B. Upon completion of all work and all tests, Contractor shall furnish the necessary skilled labor and helpers for operating the systems and equipment.

C. Contractor shall instruct the Owner's representative fully in the operation, adjustment, and maintenance of all equipment furnished.

1.10 SITE VISIT

A. Prior to preparing the bid, it is recommended that the Contractor and subcontractors shall visit the site and familiarize themselves with all existing conditions, make all necessary investigations as to locations of utilities, and all other matters which can affect the work.

B. No additional compensation will be made to the Contractor as a result of his failure to familiarize himself with the existing conditions under which the work must be performed.

1.11 DRAWINGS

A. The Contract Drawings are diagrammatic and indicate the general arrangement of systems and work included in the Contract. Any offsets, rises, or transitions not shown on the drawings and required to provide a complete system shall be provided at no additional contract cost. Do not scale the drawings. Consult the Architectural and Structural drawings and details for exact location of structure and equipment; where same are not definitely located, obtain this information from the Architect.

B. In the event of 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.

1.12 ELECTRICAL WORK

A. Under Division 23 MECHANICAL, provide the following items of electrical work which shall conform with the applicable requirements of the Electrical Division:
   1. Class 2 (24VAC or less) temperature control wiring.
      a. Refer to Section 260533 - Raceways and Boxes for Electrical Systems for installation requirements.
   2. Interlock wiring for mechanical equipment and devices.
   3. IT/network cabling between the BAS and Owner/Agency IT network.

B. Under Division 26 ELECTRICAL, provide:
   1. Power wiring, complete from power source to motor or equipment junction box, including power wiring through motor starters, power factor correction devices, and line reactors. Power factor correction devices shall be provided under Division 23 and installed under Division 26.
   2. Motor control centers or motor starter, panelboards.
   3. All miscellaneous individual motor starters, unless noted or specified otherwise.

C. Variable frequency drives will be furnished and set in place under Division 23. Power wiring shall be provided under Division 26.

1.13 SINGULAR NUMBER

A. Where any device or part of equipment is herein referred to in the singular number (such as "valve"), such reference applies to as many such devices as are required to complete the installation as shown on the drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Refer to Section 013300 "Submittal Procedures" for additional information.

B. For each specified product, provide from single manufacturer. Do not mix and match various manufactures for a single product. If various manufacturers are required for a single product, indicate reason and locations where each will be installed.

C. All component parts of each items of equipment or device shall bear the manufacturers' name plate; giving name of manufacturer, description, size, type, serial or model number, electrical characteristics, etc., in order to facilitate the maintenance or replacement. The name plate of a subcontractor or distributor will not be acceptable. Where Underwriters' Laboratories standards apply, material and equipment shall be approved by them and shall bear the UL Label.

D. In specifying materials, three (3) general procedures are used. The three (3) classifications are as follows:
   1. GROUP 1: When a material or equipment is specified by brand name or other identifying information and three (3) or more brands are named it is considered that any one (1) of the brands so named will perform as desired, and the Contractor shall base his proposal on one (1) of the named brands. The first brand named or identified basis of design shall be used as a standard. The other brands named shall be equal to the specified brand in all respects. If one (1) of the other brands named is used it shall be the Contractor's responsibility to verify proper clearances and fit of the substituted equipment.
   2. GROUP 2: When the material or equipment is specified with the phrase "...or approved equal..." after a brand name and other identifying information, it is intended that the brand name is used for the purpose of establishing a minimum acceptable standard of quality and performance and Contractor may base his bid proposal on any item which is in all respects equal to that specified and presents essentially the same appearance. It shall be the Contractor's responsibility to ensure proper fit and clearances of all substituted equipment.
   3. GROUP 3: When material is specified as complying with the requirements of published "Standard Specification" of trade associations, American Society of Testing and Materials, government specifications, etc. the Contractor shall base his proposal on any item which can be shown to comply in all respects to the referred "Standard Specification".

E. It is distinctly understood: (1) that the Architect will use his own judgment in determining whether or not any materials, equipment or methods offered in substitution are equal to those specified; (2) that the decision of the Architect on all such questions of equality is final; and (3) that all substitutions will be made at no increase in cost to the Owner.

F. Upon receipt of written approval from Architect, Contractor may proceed with substitution providing Contractor assumes full responsibility for, and makes, at his own expense, any changes or adjustments in construction or connection with other work that may be required by the substitution of such materials, equipment or methods. In the event of any adverse decisions by the Architect no claim of any sort shall be made or allowed against the Owner.

G. All pipe and fittings shall be from a United States domestic manufacturer.

2.2 INSTALLATION AND COORDINATION DRAWINGS

A. General
1. Prior to fabricating or installing work, the contractor shall prepare, submit and use composite installation and coordination drawings to assure proper coordination and installation of work. No installation or construction work shall begin until the coordination drawings are completed, submitted, and approved.
2. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems. Composite coordination drawings shall include new and existing elements, components, and systems.
3. Show relationship and integration of different construction elements that require coordination during fabrication or installation to fit in space provided or to function as intended.
4. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are important to efficient flow of Work.
5. Consideration shall be made for scheduling, sequencing, movement, and positioning of large equipment into building during construction.
6. Indicate penetrations in floors, walls, and ceilings and their relationship to assembly construction, other penetrations and installations. Identify where additional bracing and offsets are required to comply with Contract Documents.
7. Indicate any required installation sequences to minimize cutting and patching.
8. Indicate all equipment and devices indicated on wiring diagrams and schematics. Where field connections are shown to factory-wired terminals include manufacturer's literature showing internal wiring
9. Coordination Drawing Organization: Organize coordination drawings as follows:
    a. Underslab Plans: Show structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical work.
    b. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the work.
    c. Roof Plan: Show architectural and structural elements, and mechanical, plumbing, fire-protection, and electrical work. Indicate penetrations and openings required for all disciplines.
    d. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical, electrical, plumbing and fire protection components, and related work. Locate components within ceiling plenum to accommodate architectural ceiling height and layout of light fixtures indicated on Drawings.
    e. Mechanical Rooms: Show plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment and piping.
    f. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
    g. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.

10. Systems: Include, but do not necessarily limit to, the following:
    a. HVAC:
        1) All equipment and equipment bases.
        2) Size and bottom elevations of horizontal ductwork, including insulation, bracing, flanges, and support systems.
        3) Size and horizontal elevations of vertical ductwork, including insulation, bracing, flanges, and support systems.
        4) Ductwork, grilles, registers, diffusers, dampers, access panels,
        5) Maintenance clearances (including tube and filter removal), insulation installation clearances
        6) Any item that may impact coordination with other disciplines.
    b. HVAC Piping:
        1) All equipment and equipment bases.
        2) Size and bottom elevations of horizontal piping, including insulation, bracing, flanges, and support systems. Notate code required slope elevations.
        3) Size and horizontal elevations of vertical piping, including insulation, bracing, flanges, and support systems.
        4) Connections to equipment, valve and trim locations, access panels.
        5) Maintenance clearances, valve steam clearances, insulation installation clearances
        6) Any item that may impact coordination with other disciplines.
    c. Plumbing:
        1) All equipment and equipment bases.
        2) Size and bottom elevations of horizontal piping, including insulation, bracing, flanges, and support systems. Notate code required slope elevations.
        3) Size and horizontal elevations of vertical piping, including insulation, bracing, flanges, and support systems.
        4) Connections to equipment, valve and trim locations, access panels.
        5) Maintenance clearances, valve steam clearances, insulation installation clearances
        6) Any item that may impact coordination with other disciplines.
    d. Fire Protection:
        1) All equipment and equipment bases.
        2) Size and bottom elevations of horizontal piping, including bracing, flanges, and support systems. Notate code required slope elevations.
        3) Size and horizontal elevations of vertical piping, including bracing, flanges, and support systems.
        4) Connections to equipment, branch connections, drops and heads, valve and trim locations, access panels.
        5) Maintenance clearances, valve steam clearances.
        6) Any item that may impact coordination with other disciplines.
    e. Electrical and Specialty Systems:
        1) Runs of vertical and horizontal conduit 1-1/2 inches in diameter and larger and racks of smaller conduit are required.
        2) Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
        3) Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.

4) Location of pull boxes and junction boxes, dimensioned from column center lines.
5) Any item that may affect coordination with other disciplines.

f. Framing: All king studs, headers, bracing, miscellaneous framing, and any items that may affect coordination with other disciplines.

B. Production of Coordination Drawings
1. Draw plans to a scale not less than 1/4 inch equals one (1) foot in AutoCAD or REVIT format. Include plans, sections, and elevations of proposed work. Dimension all work as specified and as required for coordinated installation.
2. Reproduction of any portion of the mechanical and electrical contract drawings for re-submittal as a shop drawing is strictly prohibited. Shop drawings produced in such a manner will be rejected and returned not reviewed. Installation and coordination drawings shall be to scale reflecting actual equipment sizes purchased for the project.
3. The Construction Manager shall obtain and provide in AutoCAD or REVIT the base background documents to each contractor to establish a common platform for each contractor to use for their design drawings. Coordination will be accomplished by each Contractor superimposing his work on drawings.
4. Contractor coordination meetings shall be held continuously until the coordination drawings are complete and approved by all parties. Meetings shall be scheduled as required to complete the drawings in a timely manner as to not impact the project schedule. Additional time or compensation shall not be awarded based on the complexity or effort required to complete the coordination drawings.
5. In the event of conflicts involving location and layout of work, unless otherwise directed the Construction Manager shall use the following priority to resolve the conflict:
   a. Structure and partitions shall have highest priority.
   b. Equipment locations and access
   c. Ceiling systems and recessed light fixtures.
   d. Gravity drainage lines.
   e. Medium pressure ductwork and devices.
   f. Large pipe mains, valves and devices.
   g. Pneumatic tube and material conveying systems (where applicable)
   h. Low pressure ductwork, diffusers, registers, grilles, dampers
   i. Fire protection piping, devices and heads.
   j. Small piping, tubing, electrical conduit and devices. Conduits installed in corridors shall be maintained at least 6-9" above finished ceiling and similarly grouped and tightly spaced.
   k. Access panels.
6. Any conflicts, etc., discovered in the coordination stages prior to Contractor(s) sign-off which cannot be resolved by the Contractor(s) shall be brought to the Architect's attention for resolution.

C. Submittals
1. Submit drawing files using Portable Data File (PDF) format. Include transmittal indicating that each specialty trade has signed-off on each submitted coordination drawing.
2. For each area, submit:
   a. Composite overlay drawing of each area with all trades shown.
   b. Individual trade drawing of each area, i.e. Reflected Ceiling Plan, HVAC Ductwork, HVAC Piping, Plumbing, Fire Protection, Electrical.

3. Consultant will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Consultant determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Consultant will so inform Contractor, who shall make changes as directed and resubmit.
4. Review of coordination drawings shall not diminish responsibility under this Contract for final coordination of installation and maintenance clearances of all systems and equipment with architectural, structural, mechanical, electrical and other work.
5. Contractor is responsible for timely updates to the coordination drawings to indicate as-built conditions for their own work. Updates are required to include all changes regardless of the source or reason for the change, including changes initiated by the Owner, Architects or Engineers.

D. Installation
1. Any conflicts, etc., discovered after the created and submission of the coordination and installation drawings and during the installation of the Work will be the responsibility of the Contractor(s) to resolve with the approval of Architect. Any and all costs for these resolutions shall be solely the responsibility of the Contractor(s).
2. Work fabricated/installed prior to the completion of the coordination and installation drawings is performed at the Contractors own risk, and compensation of time/costs for corrections will not be awarded.
3. Any work installed that is not in conformance with final approved coordination and installation drawings shall be required to be removed and relocated, and compensation of time/costs for corrections will not be awarded.

2.3 FIRE-RATED PENETRATIONS

A. Provide UL Listed fire penetration systems in openings in rated floors, walls, and other elements of construction. Provide UL listed fire penetration systems at all new and existing pipe penetrations of new and existing rated construction within the area of work. Coordinate work of this section with all other trades necessary for the proper installation of the fire rated penetration systems.

B. Submit shop drawings showing each condition requiring penetration seals in dictating proposed UL systems materials, anchorage, methods of installation, and actual adjacent construction. Submit a copy of UL illustration of each proposed system indicating manufacturer approved modifications. Submit copies of manufacturer's specifications, recommendations, inspection requirements, installation instructions, and maintenance data for each type of material required. Include letter indicating that each material complies with the requirements and is recommended for the applications shown.

C. All fire penetration systems shall reference ASTM E814/UL 1479 - Fire Test of Through - Penetration Fire Stops.

D. All systems shall be UL tested and listed in the UL Fire Resistance Directory.

E. Submit copies of written guarantee agreeing to repair or replace joint sealers which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability or appear to deteriorate in any other manner not

clearly specified by submitted manufacturer's data as an inherent quality of the material for the exposure indicated. The guarantee period shall be one (1) year from date of substantial completion.

F. 3M products have been specified as the penetration fire stop basis of design. Other manufacturer's systems are acceptable providing they meet the requirements set forth in this specification. The fire rated penetration systems shall be the products of one manufacturer to the maximum extent possible. The products of more than one manufacturer shall not be used as a combined seal.

G. Provide materials classified by UL to provide fire stopping equal to time rating, both "F" and "T" ratings, of construction being penetrated. Provide asbestos free materials that comply with applicable codes and have been tested under positive pressure in accordance with UL 1479 or ASTM E814. Systems shall be smoke and air tight.

H. Deliver material undamaged in manufacturer's clearly labeled, unopened containers identified with brand, type, grade, and UL label where applicable. Coordinate delivery with scheduled installation date to allow minimum storage time at site. Store material in clean, dry ventilated location. Protect from soiling, abuse, and moisture. Follow manufacturer's instruction.

I. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding. Proceed with installation only after penetrations of the substrate and supporting brackets have been installed.

J. Furnish adequate ventilation if using solvent. Furnish forced air ventilation during installation if required by manufacturer. Keep flammable materials away from sparks or flame. Provide masking and drop cloths to prevent contamination of adjacent surfaces by fire stopping resistance.

K. Clean surfaces to be in contact with penetration seal materials, of dirt, grease, oil, loose, materials, rust, or other substances that may affect proper fitting, adhesion of the required fire resistance.

L. Install penetration seal materials in accordance with printed instructions of the UL Fire Resistance Directory and in accordance with manufacturer's instructions. Seal holes or voids made by penetrations to ensure an effective smoke barrier. Where floor openings without penetrating items are more than four (4) inches in width and subject to traffic or loading, install fire stopping materials capable of supporting same loading as floor. Protect materials from damages on surfaces subject to traffic.

M. Clean up spills of liquid components. Neatly cut and trim materials as required. Remove equipment, materials, and debris, leaving area in undamaged, clean condition.

N. Examine penetration sealed areas to ensure proper installation before concealing or enclosing areas. Keep areas of work accessible until inspection by applicable code authorities. Perform under this section patching and repairing of fire stopping caused by cutting or penetration by local inspectors and other trades.

2.4 DRIVES FOR MACHINERY

A. Equip each motor driven machine with a V-belt drive except those which are specified as direct drive. Where factory designed and assembled belt drives which do not conform to the following are proposed to be furnished, such non-conformity must be noted on the shop drawings submittals and may be cause for rejection of the item.

B. Provide OSHA approved guards, for all belt drives, constructed in accordance with SMACNA standards. Submit shop drawings for approval.

C. Select each drive according to the ratings and recommendations of the manufacturer for the service with which used, giving proper allowance for sheave diameter, center distance, and arc of contact less than one hundred eighty degrees. Size the motor driving a pump or fan to have a nameplate rating of not less than ten (10) percent above the total of actual brake horsepower and drive loss at specified capacity.

D. Belts shall be constructed of endless reinforced cords of long staple cotton, nylon, rayon, or other suitable textile fibers imbedded in rubber. Use belt with correct cross section to fit properly the sheave grooves. Carefully match belts for each drive.

E. Provide any changes to the sheaves, belts, pulleys or drive package to obtain specified airflow.

F. Select the motor of a capacity needed to operate the equipment at the specified mid-position operating condition. Where non-overloading motors are specified, select the motor capacity rating at the most closed position of the motor sheave. In no case shall motors be a smaller size than those indicated on the drawings.

G. Do not select fan sheave smaller in diameter than thirty (30) percent of the fan wheel diameter.

H. Construct sheaves of cast iron or steel, bored to fit properly on the shafts, and secured with key ways of proper size (not set screws). Key ways may be omitted for sheaves having 1/2 inch or smaller bores where set screws may be used.

PART 3 - EXECUTION

3.1 WORKMANSHIP

A. The quality of workmanship required, for each trade, in the execution of work shall be the finest and highest obtainable in that trade working with the materials specified. Workmanship shall be satisfactory to the Architect and his decision as to acceptable quality is final.

B. Workmanship proven to be of poor quality or unsatisfactory in the commissioning phase of the project as deemed by the Architect shall be removed and replaced to the satisfaction of the Architect.

3.2 EQUIPMENT PERFORMANCE

A. All equipment, devices, controls, and hardware shall be proven to operate successfully throughout the guarantee period. Systems shall be proven during all-weather seasons and be demonstrated to affect the design conditions at times. System components or equipment items that fail to consistently deliver the design conditions shall be removed and replaced as directed by the Architect. The cost of required equipment replacements shall be borne by the Contractor.

B. All equipment shall be tested after installation and be proven to deliver the manufacturers quoted design capacity. When capacity is in question as deemed by the Architect, the Contractor shall perform a detailed and comprehensive field performance test to certify the equipment capacity. System effect or installed performance factors may not be applied to performance ratings unless they were previously included when the equipment was submitted for approval. Equipment that fails to deliver manufacturers quoted design capacity shall be removed and replaced at the Contractors expense.

C. Workmanship proven to be of poor quality or unsatisfactory in the commissioning phase of the project as deemed by the Architect shall be removed and replaced to the satisfaction of the Architect.

3.3 EQUIPMENT CONNECTIONS

A. All equipment shall be installed and connected in accordance with the best engineering practice and in accordance with manufacturer's instructions and recommendations. Auxiliary piping, piping specialties, water seals, valves, and electric connections recommended by the manufacturer, required by code or required for proper operation shall be provided.

3.4 CUTTING AND PATCHING

A. Cutting and patching associated with the work shall be performed in a neat and workmanlike manner. Existing surfaces, which are damaged by the Contractor, shall be repaired or provided with new materials. All patching shall be done with materials and methods similar to existing adjacent work, subject to approval of the Architect. Structural members shall not be cut or penetrated. Holes cut through concrete and/or masonry to accommodate new work shall be cut by reciprocating or rotary, non-percussive methods.

B. Patching of areas disturbed by installation of new work shall match existing adjacent surfaces in material, texture, and color.

3.5 PROTECTION OF EXISTING WORK

A. When working in and around the building, extreme care shall be exercised with regard to protection of the structure and mechanical services. Repair or replace, to the satisfaction of the Architect, any existing work damaged in the performance of the new work.

3.6 SURVEYS AND MEASUREMENTS

A. Base all measurements (both horizontal and vertical) from established bench marks. All work shall agree with these established lines and levels. Verify all measurements at site and check correctness of same as related to the work. Verify locations of existing utilities and inverts of same prior to the start of any systems shown connecting to existing utilities.

B. Should the Contractor discover any discrepancy between actual measurements or conditions, and those indicated, which prevent following good practice or the intent of the drawings and specifications, he shall notify the Architect and shall not proceed with his work until he has received instruction from the Architect.

3.7 WELDING

A. Welding shall conform to current standards and recommendations of the National Certified Pipe Welding Bureau, with all South Carolina Occupational Safety and Health Acts, State, City and County Fire Prevention Code Requirements, and NFPA Standard 241 including provision of appropriate portable fire extinguishers.

B. Before assigning any welders to work covered by this specification, the Contractor shall provide the Architect with the names of pipe welders to be employed for the work, together with each welder's assigned number, letter, or symbol which shall be used to identify the work of that welder and which shall be affixed immediately upon completion of each weld. Contractor shall also submit, with the list of names, copies of each welder's certified qualification tests prescribed by the National Certified Welding Bureau or by other reputable testing laboratory using procedures covered in the American Society of Mechanical Engineers Building Construction Code, Section IX, "Qualification Standard Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators". Welders must be certified for all positions.

C. If requested by the Architect, the Contractor shall submit identifying stenciled test coupons made by any welder in question. The Contractor shall require any welder to retake the tests when, in the opinion of the Architect, the work of the welder creates a reasonable doubt as to his proficiency. Tests, when required, shall be conducted at no additional expense to the Owner; and the welder in question shall not be permitted to work as a welder on this project until he has been recertified. Recertification of the welder shall be made to the Architect only after the welder has taken and passed the required test; welder must pass the test without benefit of retests in order to resume work as a welder on this project.

D. Welding shall conform to the ANSI Code for Pressure Piping ANSI B31.9, Building Services Piping. The Contractor shall be responsible for the quality of welding and shall repair or replace any work not in accordance with these specifications. Contractor shall, without cost to the Owner, check welds by radiograph, ultrasonic testing, sectioning or a combination of these methods wherever there is a question raised by the Architect as to the quality of a weld. Examination of the questionable weld shall be in addition to other system tests specified. Welds shall have penetration complete to the inside diameter of the pipe. The recommended spacing and levels between ends of pipes prior to welding shall be used in all cases to assure full penetration.

E. Welders on pressure piping shall be certified and carry their identification stamp with them. Welds on lines with operating pressures above 100 psig shall be stamped.

3.8 HANDLING AND STORAGE OF MATERIAL

A. Proper and suitable tools, equipment and appliances for the safe and convenient handling and placing of all materials and equipment shall be used. During loading, unloading, and placing, care shall be taken in handling the equipment and materials so that no equipment or materials are damaged.

B. All equipment delivered to the job site shall be stored on pedestals, above the ground and under roof or other approved covering. All enclosures for equipment shall be weatherproof. All motors, drives, switchgear, panels, etc. which are not totally enclosed, that are involved in the work, shall be stored in a heated, dry, water protected area with a minimum temperature of fifty degrees (50) Fahrenheit. All valves shall be stored under roof on wood pedestals, above ground. All insulation shall be stored under roof or in trailers, adequately protected from the weather. The Contractor shall follow all written instructions and recommendations of the manufacturer and all requirements of the Architect in oiling, protection and maintenance of equipment during storage. It shall be the Contractor's complete responsibility for the storage and care of the equipment and materials.

C. If any equipment and/or materials are found to be in poor condition at the time of installation the Architect may, at his discretion, order the Contractor to furnish and install new equipment and/or material at no cost to the Owner.

3.9 COOPERATION WITH OTHER TRADES

A. Mechanical trades shall give full cooperation to other trades and shall furnish in writing, with copies to Architect any information necessary to permit the work of all trades to be installed satisfactorily and with least possible interference or delay. Exact location of all mechanical and equipment, devices, etc. in finished spaces shall be coordinated with Architectural reflected ceiling plans, elevations and details.

3.10 CLEANING AND PAINTING

A. Thoroughly clean all exposed surfaces of equipment and material and leave in a neat, clean condition.

B. Restore and touch-up factory finishes which have been damaged during construction.

C. For areas of exposed rust, treat with water-based emulsion chemical rust converter. Brush, roll, or spray on the surface to be treated and allow to cure prior to paint/surface touch-up. Basis of design is Ultra Last CuRUST Chemical Rust Converter.

3.11 ACCESSIBILITY

A. Equipment shall be installed per manufacturer's recommended clearance guidelines with sufficient space for maintenance personnel service, operate, and maintain equipment.

B. Locate all above ceiling equipment which must be serviced, operated, or maintained, in fully accessible positions to eliminate the need for access panels and doors. Equipment shall include, but not be limited to, valves, clean-outs, motors, controllers, dampers, drain points, etc.

C. Where overhead equipment cannot be located above spaces with either no ceilings or removable acoustical ceiling tiles, contractor shall provide, as part of the contract and no expense to the Owner, fourteen (14) gauge painted steel access doors where required and/or where directed (color shall match ceiling).
   1. Access doors shall be Milcor or approved equal to suit material in which installed.
   2. Access doors installed in fire rated walls or shafts shall be labeled and shall match rating of the construction.
   3. Doors shall be of sufficient size to allow access to all components; minimum size shall be eighteen (18) inches by eighteen (18) inches.
   4. Doors in Toilet Rooms and Janitor's Closets shall be Type 304 stainless steel.
   5. All doors shall have cylinder locks operable from same key.
   6. Submit shop drawings for approval. Locations shall be coordinated with the Architect and indicated on the composite installation and coordination drawings

D. Equipment deemed inaccessible by the Architect shall be reworked by the Contractor at no expense to the Owner.

3.12 EQUIPMENT BASES AND SUPPORTS

A. Concrete bases, curbs, and supports will be furnished and installed under this Division and shall be in accordance with Division 3.

B. The Subcontractors shall furnish, to the General Contractor, all required foundation sizes, bolts, washers, sleeves, plates and templates for equipment.

C. The size of the foundation bolts shall be as recommended by the manufacturer.

D. All equipment shall be set on the foundations, shimmed level with steel shims, and grouted up under base for uniform bearing by the Subcontractor.

E. Under this Section, provide all equipment supports; consisting of inertia pads, platforms, gratings, structural members and related materials required for the mechanical and electrical work.

F. The type and size of the supporting channels and supplementary steel shall be determined by the Subcontractor and shall be of sufficient strength and size to allow only a minimum deflection in conformance with the manufacturer's requirements for loading.

3.13 DEMOLITION

A. All existing piping, conduit, equipment, ductwork, and materials not required for re-use or re-installation shall be removed. Any existing materials and equipment which are removed and are desired by the Owner or are indicated to remain the property of the Owner, shall be delivered to him on the premises by the Contractor where directed by the Architect. All other materials and equipment which are removed shall become the property of the Contractor and shall be removed by him from the premises.

B. Existing piping that remains concealed, buried, or otherwise contained in the remaining slabs and walls shall be capped, plugged, or otherwise sealed. All pipes shall be cut so that their capped or plugged ends will be below the finished floors or behind finished surfaces.

C. Existing wiring, where possible, shall be removed or pulled through conduits. Wiring remaining shall be cut back behind the termination of conduits so that conduits can be adequately capped, plugged, or sealed.

3.14 CONNECTIONS AND ALTERATIONS TO EXISTING WORK

A. When existing mechanical work is removed, all pipes, valves, ducts, and materials shall be removed to a point below the finished floors or behind finished walls and capped. Such points shall be far enough behind finished surfaces to allow for the installation of the normal thickness of finished material.

B. When the work specified hereinafter connects to existing equipment, piping, or ductwork, the Contractor shall perform all necessary alterations, cuttings, or fitting of existing work as may be necessary or required to make satisfactory connections between the new and existing work and to leave the completed work in a finished and workmanlike condition, to the entire satisfaction of the Architect.

C. When the work specified hereinafter or under other divisions of the contract necessitates relocation of existing equipment, piping, or ductwork, the Contractor shall perform all work and make all necessary changes to existing work as may be required to leave the completed work in a finished and workmanlike condition, to the satisfaction of the Architect. All work resulting in an extra to the contract shall be approved by the Owner and Architect before proceeding.

D. All cutting and patching necessary for the installation of the mechanical work shall be done under this Division. Any damage done to the work already in place shall be repaired at the Contractor's expense. Patching shall be uniform in appearance and shall match the surrounding surface.

E. When the work specified hereinafter connects to existing piping, to avoid possible cross-connection of supply and return lines, the Contractor shall field verify the configuration of supply and return lines, using an appropriate temperature sensing or pressure device, before making final connections. Any discrepancy between construction documents and field verification should be promptly reported to the Architect before completing piping installation, so proper piping configuration can be verified.

3.15 INTERRUPTION OF EXISTING UTILITIES

A. Notify the Owner in writing at least ten (10) calendar days in advance of any required shutdown of water, sewage, gas, electrical service or other utility. Upon written receipt of approval from Owner, shutdowns shall be performed between the hours of six (6) p.m. and six (6) a.m. including clean-up or as directed otherwise and shall be accomplished at no additional cost.

B. At the end of each interruption, all services shall be restored so that normal use of the building can continue.

3.16 MOLD AND CONDENSATION PREVENTION DURING CONSTRUCTION

A. Piping Systems: Cold piping systems shall not be operated prior to insulation and vapor barrier installation in order to prevent condensation on the piping.

B. Air Systems: Air handling systems shall not be operated prior to insulation and vapor barrier installation in order to prevent condensation on the ductwork. Air systems shall not be operated in portions of the building not yet fully enclosed, where systems can be exposed to warm, humid air conditions.

C. Room thermostats shall not be set lower than 74 degrees F.

D. Contractor shall notify the Architect immediately if signs of condensation or mold are discovered.

END OF SECTION 230500

SECTION 230800 - COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.

B. Related Sections:

Section 019113 "General Commissioning Requirements" for general commissioning process requirements.

1.3 DEFINITIONS

A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

B. CxA: Commissioning Authority.

C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.

D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates of readiness.

B. Pre-Functional Test Checklists and equipment start up reports

1.5 CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests at the direction of the CxA.

B. Attend construction phase commissioning kick-off meeting.

C. Attend construction phase controls coordination meetings.

D. Attend testing, adjusting, and balancing review and coordination meetings.

E. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.

F. Provide information requested by the CxA for final commissioning documentation.

G. Provide measuring instruments and logging devices, calibrated within one year of date of test unless specifications or industry standards require more stringent calibration periods, to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.6 CxA'S RESPONSIBILITIES

A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

B. Direct commissioning testing.

C. Verify testing, adjusting, and balancing of Work are complete.

D. Organize Contractor provided test data, inspection reports, and certificates in Systems Manual.

1.7 COMMISSIONING DOCUMENTATION

A. Provide the following information to the CxA for inclusion in the commissioning plan:
1. Plan for delivery and review of submittals, operation and maintenance manuals, and other documents and reports.
2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
6. Test and inspection reports and certificates.
7. Corrective action documents.
8. Verification of testing, adjusting, and balancing reports.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Provide a fully executed Certificate of Readiness signed by Contractor, Subcontractors, TAB Agent and BAS provider certifying that HVAC&R Systems, instrumentation and control systems have been completed and calibrated, pre-tested and inspected and that they are operating according to the Contract Documents, and that pretest set points have been recorded. Provide completed Certificate of Readiness to CxA no less than 7 days prior to the scheduled beginning of on-site CxA verification testing.

B. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.

C. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

D. Inspect and verify the position of each device and interlock identified on checklists.

E. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

F. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 TESTING, ADJUSTING AND BALANCING VERIFICATION

A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.

B. Notify the CxA at least 30 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.

C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.

D. The CxA will notify testing, adjusting and balancing Subcontractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
1. The testing and balancing Subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.
2. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
3. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space.

C. Cx Testing of systems and equipment shall include measuring capacities and effectiveness of operational and control functions in addition to or in conjunction with any statutory and regulatory testing required by Authorities Having Jurisdiction over the project and testing required in other Sections of this Project Manual.

D. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

E. The CxA along with the HVAC&R Subcontractor, testing and balancing Subcontractor, and HVAC&R Instrumentation and Control Subcontractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.

F. Tests will be performed using design conditions whenever possible.

G. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

H. The CxA may direct that set points be altered when simulating conditions is not practical.

I. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

J. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

K. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.4 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

A. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Section 230900 "Instrumentation And Control For HVAC." Assist the CxA with preparation of testing plans.

B. Refrigerant System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

C. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of special exhaust; and other distribution systems, including HVAC&R terminal equipment, dedicated outdoor air delivery and heat recovery equipment and unitary equipment.

D. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.

END OF SECTION 230800

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR MECHANICAL EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, induction motors for use on alternating-current power systems and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

1.4 SUBMITTALS

A. Shop Drawings and Product Data: Shop drawings and product data for motors shall be provided with the submittal package for the piece of equipment that it serves. In accordance with Division 01, Section "Submittals" provide the following:
1. Product catalog data: nameplate data and ratings; materials of construction; mounting arrangement, size and location of motor terminal box and conduit entry, grounding lugs and coatings.

B. Warranties
1. In addition to the warranty requirements of the General Conditions, warranties for each motor shall be covered in the warranty for the entire mechanical assembly (fan & motor, pump and motor, etc).

C. Manufacturer Seismic Qualification Certification: Submit certification that motors, accessories, and components will withstand seismic forces defined in Division 23, Section "Mechanical Vibration, Sound and Seismic Controls." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Operation and Maintenance Data: For factory-installed motors to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain factory-installed motors through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70, "National Electrical Code."

D. NRTL Listing: Motors shall be NRTL-listed.
1. Term "Listed": As defined in "National Electrical Code," Article 100.
2. Listing Agency Qualifications: "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.

E. Comply with NEMA MG 1, "Motors and Generators."

F. Comply with UL 1004, "Motors, Electric."

G. Provide factory test reports in accordance with Part 2 of this Section.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Whenever possible, motor and driven equipment shall be shipped complete as an entire assembly.

B. Inspect equipment immediately upon arrival and any irregularities or damage shall be reported to the Manufacturer/Supplier immediately.

C. Store in accordance with manufacturer's recommendations.

1.7 IDENTIFICATION

A. Nameplates: All motors shall have a stainless steel nameplate attached with stainless steel fasteners on the motor. The nameplate shall be stamped with nameplate markings listed in NEMA MG 1 20.60, plus the following:
   1. Manufacturer
   2. Model Number
   3. Serial Number
   4. Nominal efficiency
   5. Minimum efficiency
   6. Temperature Rise
   7. Bearing manufacturer's name and catalog number

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Motor requirements apply to factory-installed motors except as follows:
   1. Different ratings, performance, or characteristics for motor are specified in another Section.
   2. Motorized-equipment manufacturer requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.

C. Contractor assumes responsibility for the correct direction of rotation required by the equipment drives. In the event of damage due to reverse rotation, the equipment shall be repaired or replaced at no charge to the Owner.

D. Motor Bearings: Motor bearings shall be specifically designed for the drive application, and shall be approved by the Engineer. Bearings shall have a minimum bearing life of B-10 or L-10 as defined by the AFBMA. Bearings shall be designed to carry the total hydraulic and static thrust developed by the driven load. Bearings shall be grease or oil lubricated. Oil lubricated motors shall be fitted with gravity-feed oil reservoirs. Grease lubricated bearings shall be regreasable (not sealed) and shall be supplied with grease fittings and drain plugs. Medium voltage and variable frequency controlled motor bearings shall be electrically isolated from the shaft on at least one end to prevent transmission of electric current. Current drain brushes shall be fitted where it is necessary to divert the flow of electrical current from bearings. Bearings, housing and brackets shall be constructed to permit access, removal and replacement of the bearings without disassembly of the motor.

E. Rotor: The rotor shall be dynamically and statically balanced. Assembled motor shall be tested at the factory in accordance with latest applicable NEMA MG 1and IEEE 112 methods of testing, and balanced at no more than 0.001 inches total peak-to-peak deflection on the bearing housing and the shaft. Overall vibration readings, including all vibration frequencies, shall be taken and recorded at no load and design speed.

F. Terminal Box: Motors shall have a watertight cable terminal box. Terminal box shall be oversized, diagonally split, and rotatable in 90o increments to allow conduit and cable entry from top, bottom and sides.

G. Motor Leads: Motor leads shall be a minimum of 6 inches in length. All motor leads shall be extended from the conduit box. Motors rated over 200 HP or over 600V shall have insulated tin plated copper busbar terminals with bolt holes for compression wire lugs.

H. Drains and Breathers: Provide drain(s) in the bottom of the motor at the lowest point(s). Enclosed motors shall be fitted with breathers.

I. Screens: Provide stainless steel screens at motor ventilation openings.

J. Motor Shaft: The motor shaft shall be ASTM A322 GR140 (AISI 4140) steel and shall be sized to accommodate the required power and torque. Provide shaft end with keyway for connection to coupling with the pump shaft. Coordinate shaft design requirements with driven load.

K. Stainless Steel Hardware: Provide corrosion resistant hardware for motor components including grease fittings, plugs, nuts, bolts, washers and screws.

L. Motor Casing and Coating: Housings shall be degreased, primed and painted both inside and outside with a rust inhibitive primer and corrosion resistant polyester paint. Painting shall be performed prior to installing the motor stator windings. The primer and paint materials selected shall be suitable for the environment encountered, both inside and outside of the casing.

M. Motors connected to Variable Frequency Drives shall be "inverter duty" with additional magnet wire insulation to achieve a minimum motor impulse voltage rating equal to the VFD manufacturer's recommendations for the motor, cable size, and cable length actually installed.

N. Shaft Grounding Ring: Each motor shaft shall be provided with a Shaft Grounding Ring (SGR) that will provide a reliable low resistance path from the motor shaft to the motor frame to prevent the buildup of destructive high frequency shaft currents that are created by the Pulse Width Modulation of the Variable Frequency Drive units. The SGR shall encircle the shaft and shall be designed to promote efficient discharge of the high frequency shaft currents to the motor frame. The motor frame shall be inherently grounded by design.

O. Power Factor Correction Capacitors: Provide motor power factor correction capacitors for all motors rated 600V or less (except variable frequency controlled motors) with less than 90% uncorrected power factor. Motor power factor correction capacitors shall be sized as recommended by the motor manufacturer to correct the motor power factor to over 90%. Motor power factor correction capacitor sizes shall not be larger than the maximum size recommended by the motor manufacturer. Enclosure type shall be NEMA 12. Capacitors shall be dry film type with fuses and discharge resistors.

P. Composite Factor: Each motor, 1 HP or larger, or motor driven equipment, 1 HP or larger shall have a composite power factor (PF) rating of ninety (90) percent to 100 percent when the driven equipment is operating at the design duty defined on the drawings. Power factor correction devices shall be provided to meet the stated criteria.

Q. Devices such as capacitors, or equipment such as solid state power factor controllers, shall be provided as part of the motor or item of motor driven equipment when required for power factor correction. Devices shall be completely mounted and wired to the motor terminal except as follows:
   1. For a motor or motor driven equipment requiring other than across-the-line starting, power factor (PF) correcting capacitors, or other equipment, shall be connected to motor terminals via a contactor (controller) with a 120 volt alternating current (VAC) coil. The 120 volt alternating current (VAC) coil shall be energized via an auxiliary contact on the contactor (controller) used to establish the "run" operating mode for the motor driven equipment.
   2. For two (2) speed motors, power factor (PF) shall be corrected at each speed via separate groups of capacitors or other equipment for each speed. Each group of PF correcting components shall be connected to motor terminals via a separate contactor (controller) with a 120 volt alternating current (VAC) coil. Each 120 volt alternating current (VAC) coil shall be energized via an auxiliary contact on the contactor or controller used to establish "run" operations at each speed.

R. Locked rotor kVA shall not exceed NEMA Code Letter F for motors over 10 horsepower.

S. Motors shall have the following enclosure types in accordance with NEMA MG 1:
   1. For clean dry indoor areas: open drip proof (ODP) fully-guarded
   2. For outdoor locations: totally-enclosed fan-cooled for small and medium machines, weather protected type II for large machines
   3. Explosion-proof machines shall be provided for hazardous areas classified in accordance with NFPA 70 (National Electrical Code). Explosion proof motors shall be NRTL-listed for the hazardous area classification.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

C. Motors ½ HP and Larger: Three phase, unless otherwise indicated.

D. Motors Smaller Than ½ HP: Single phase.

E. Frequency Rating: 60 Hz.

F. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Stator: Copper windings, unless otherwise indicated.
1. Multispeed Motors: Separate winding for each speed.

E. Rotor: Random-wound, squirrel cage.

F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: One temperature rise one class below the insulation rating class; for example, Class B temperature rise with Class F insulation.

H. Insulation: Class F, unless otherwise indicated.

I. Code Letter Designation:
1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.

J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width-modulated inverters.
2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.

2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION

3.1 COMMISSIONING

A. Check operating motors for unusual conditions during normal operation. Coordinate with the commissioning of the equipment for which the motor is a part.

B. Report unusual conditions.

C. Correct deficiencies.

END OF SECTION 230513

SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.

B. Related Requirements:

1. Division 07 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, Inc
2. CALPICO, Inc
3. GPT; an EnPro Industries company

B. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.

C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, anticorrosion coated or galvanized, with plain ends and integral welded waterstop collar.

D. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, Inc
2. CALPICO, Inc
3. GPT; an EnPro Industries company
4. Metraflex Company (The)
5. Proco Products, Inc
6. Trumbull Industries

B. Description:
1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
2. Designed to form a hydrostatic seal of 20 psig minimum.
3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
4. Pressure Plates: Carbon steel.
5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B 633 of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, Inc
2. CALPICO, Inc
3. GPT; an EnPro Industries company
4. Metraflex Company (The)
5. Proco Products, Inc
6. Trumbull Industries

B. Description:
1. Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.
2. Plastic or rubber waterstop collar with center opening to match piping OD.

2.4 GROUT

A. Description: Nonshrink, 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.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. Fasten sleeves securely in floors and walls so that they will not become displaced when concrete is poured or when other construction is built around them. Take precautions to prevent concrete, plaster or other materials from being forced into space between pipe and sleeve during construction

C. 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.

D. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
   2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

E. 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 minimum 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

F. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration,

assemble sleeve-seal-system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings as new walls and slabs 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 space around outside of sleeve-seal fittings.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.

B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:
   a. Piping Smaller Than NPS 6: Steel pipe sleeves or sleeve-seal fittings.
   b. Piping NPS 6 and Larger: Steel pipe sleeves or sleeve-seal fittings.

2. Concrete Slabs above Grade:
   a. Piping Smaller Than NPS 6: Steel pipe sleeves or sleeve-seal fittings.
   b. Piping NPS 6 and Larger: Steel pipe sleeves.

3. Interior Partitions:
   a. Piping Smaller Than NPS 6: Steel pipe sleeves.
   b. Piping NPS 6 and Larger: Galvanized-steel sheet sleeves.

END OF SECTION 230517

SECTION 230518 - ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.3 DEFINITIONS

A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. BrassCraft Manufacturing Co.; a Masco company
2. Dearborn Brass
3. Keeney Manufacturing Company (The)
4. Mid-America Fittings, Inc.
5. ProFlo; a Ferguson Enterprises, Inc. brand

2.2 ESCUTCHEONS

A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.

C. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

D. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel or brass with polished, chrome-plated finish and spring-clip fasteners.

E. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.

F. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

2.3 FLOOR PLATES

A. Split Floor Plates: Steel with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for exposed piping penetrations of finished walls, ceilings, and floors.

B. Install escutcheons on bare piping to be compatible with pipe material:
1. Copper Piping: Brass
2. Ferrous Piping: Steel.
3. Plastic Piping: Steel.
4. Stainless Steel Piping: Stainless Steel.

C. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
1. Escutcheons for New Piping and Relocated Existing Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
b. Chrome-Plated Piping: One-piece or split-plate, with concealed hinge with polished, chrome-plated finish.
c. Insulated Piping: One-piece or split-plate with concealed hinge with polished, chrome-plated finish.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece or split-plate with concealed hinge with polished, chrome-plated finish.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-plate with concealed hinge with polished, chrome-plated finish.
f. Bare Piping in Unfinished Service Spaces: One-piece or split-plate with concealed hinge with polished, chrome-plated finish.
g. Bare Piping in Equipment Rooms: One-piece or split-plate with concealed hinge with polished, chrome-plated finish.

2. Escutcheons for Existing Piping to Remain:

a. Chrome-Plated Piping: Split-plate with concealed hinge with polished, chrome-plated finish.
b. Insulated Piping: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate with concealed hinge with polished, chrome-plated finish.
d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate with concealed hinge with polished, chrome-plated finish.
e. Bare Piping in Unfinished Service Spaces: Split-plate with concealed hinge with polished, chrome-plated finish.
f. Bare Piping in Equipment Rooms: Split-plate with concealed hinge with polished, chrome-plated finish.

D. Install floor plates for exposed piping penetrations of floors in finished areas with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping and Relocated Existing Piping: One-piece, floor plate.
2. Existing Piping: Split floor plate.

3.2 FIELD QUALITY CONTROL

A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 230518

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal hanger-shield inserts.
4. Fastener systems.
5. Pipe stands.
6. Pipe-positioning systems.
7. Equipment supports.

B. Related Requirements:
1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 230516 "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
3. Section 230548 "Vibration and Seismic Controls for HVAC" for vibration isolation devices.
4. Section 230548 "Vibration Controls for HVAC" for vibration isolation devices.
5. Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts" for duct hangers and supports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
1. Trapeze pipe hangers.
2. Pipe stands.
3. Equipment supports.

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, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
   1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
   2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
   3. Design seismic-restraint hangers and supports for piping and equipment.

2.2 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, hot-dip galvanized, or electro-galvanized.
   3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
   4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
   5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Stainless-Steel Pipe Hangers and Supports:
   1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
   3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe and Tube 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.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 THERMAL HANGER-SHIELD INSERTS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Pipe Shields Inc or comparable product by one of the following:
   1. Carpenter & Paterson, Inc
   2. Clement Support Services
   3. ERICO International Corporation
   4. Insulation Components, Inc.
   5. National Pipe Hanger Corporation
   6. Pipe Shields Inc.
   7. Piping Technology & Products, Inc
   8. Rilco Manufacturing Co., 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 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 shall cover entire circumference of pipe. Shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Hilti, Inc.
      b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
      c. MKT Fastening, LLC
      d. Simpson Strong-Tie Co., Inc.

B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. B-line, an Eaton business
      b. Hilti, Inc.
      c. ITW Ramset/Red Head; Illinois Tool Works, Inc.
      d. MKT Fastening, LLC
   2. Indoor Applications: Zinc-coated or stainless steel.
   3. Outdoor Applications: Stainless steel.

C. Per IBC Section 1912 and ACI 318 Appendix D, all concrete anchors within the scope of ACI 318 require approved anchors for crack concrete. Attachment devices shall have certified load test data from an independent test laboratory and shall be capable of carrying a minimum of five times the design load. The concrete anchors for the following supported items need to meet the crack concrete requirements:
   1. Any suspended pipe, larger than 2", regardless of material.
   2. All components with an Ip 1.5.
   3. All components required to function after a seismic event.
   4. Anywhere required by ASCE 7.
   5. All suspended HVAC and air distribution equipment, including air handling units, supply air terminal units, fan coil units and fans.

2.6 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand:
   1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
   2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
   3. Hardware: Galvanized steel or polycarbonate.
   4. Accessories: Protection pads.

C. Low-Profile, Single-Base, Single-Pipe Stand:
   1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
   2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
   3. Vertical Members: Two galvanized-steel, continuous-thread, 1/2-inch rods.
   4. Horizontal Member: Adjustable horizontal, galvanized-steel pipe support channels.
   5. Pipe Supports: Roller or strut clamps.
   6. Hardware: Galvanized steel.
   7. Accessories: Protection pads.
   8. Height: 12 inches above roof, unless otherwise noted.

D. High-Profile, Single-Base, Single-Pipe Stand:

1. Description: Single base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Single vulcanized rubber or molded polypropylene.
3. Vertical Members: Two galvanized-steel, continuous-thread, 1/2-inch rods.
4. Horizontal Member: One adjustable-height, galvanized-steel, pipe-support slotted channel or plate.
5. Pipe Supports: Roller, clevis hanger or swivel hanger.
6. Hardware: Galvanized steel.
7. Accessories: Protection pads, 1/2-inch, continuous-thread, galvanized-steel rod.
8. Height: 36 inches above roof, unless otherwise noted.

E. High-Profile, Multiple-Pipe Stand:
1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: Two or more; vulcanized rubber or molded polypropylene.
3. Vertical Members: Two or more, galvanized-steel channels.
4. Horizontal Members: One or more, adjustable-height, galvanized-steel pipe support.
5. Pipe Supports: Roller, strut clamps, clevis hanger or swivel hanger.
6. Hardware: Galvanized steel.
7. Accessories: Protection pads, 1/2-inch, continuous-thread rod.
8. Height: 36 inches above roof, unless otherwise noted.

F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.8 MATERIALS

A. Aluminum: ASTM B 221.

B. Carbon Steel: ASTM A 1011/A 1011M.

C. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; galvanized.

D. Stainless Steel: ASTM A 240/A 240M.

E. Threaded Rods: Continuously threaded. Zinc-plated or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar materials as rods.

F. Grout: ASTM C 1107/C 1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.

2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported operating components with a design safety factor of not less than five.

3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
3. The use of cable ties, zip ties and/or tie wraps for attaching piping to metal trapeze pip-hanger is prohibited. Provide appropriate strut clamps, brackets and/or similar attachments to properly secure piping to trapeze pipe-hangers.

C. Thermal-Hanger Shield Installation: Install in pipe hanger for insulated piping.

D. Fastener System Installation:
1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

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 Section 077200 "Roof Accessories" for curbs.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes 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: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
4. Shield Dimensions for Pipe: Not less than the following:
    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.
    c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 2-1/2 and Larger: Include thermal hanger shield inserts of length at least as long as protective shield. Insert thickness shall be the same thickness as piping insulation. Fill interior voids with insulation that matches adjoining insulation and seal as appropriate.

N. In no case shall wire or perforated strap be used for pipe or conduit support.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 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-inch.

3.6 PAINTING

A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A 780/A 780M.

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-58 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications with field-applied finish.

D. Use hangers and supports with electro-galvanized coatings for piping and equipment that will not have field-applied finish.

E. Use hot dip galvanized pipe hangers and stainless-steel attachments for exterior applications. Zinc plated hangers and attachments are not acceptable for exterior use.

F. Use stainless-steel pipe hangers and stainless-steel attachments for corrosive environment applications. Zinc plated hangers and attachments are not acceptable for corrosive use.

G. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

H. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

I. Use padded hangers for piping that is subject to scratching.

J. Use thermal-hanger shield inserts for insulated piping and tubing.

K. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
   2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
   3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
   4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
   5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
   6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
   7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is unnecessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is unnecessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

L. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

M. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

N. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.

2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

O. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

P. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.

7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

Q. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC

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.

B. The International Building Code and ASCE/SEI 7 Standard apply to all work associated with the seismic installation of all new mechanical piping and equipment. Refer to Structural drawings and ASCE/SEI 7 for seismic and wind loads and additional information.

1.2 SUMMARY

A. Section Includes:
1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Open-spring isolators.
5. Housed-spring isolators.
6. Restrained-spring isolators.
7. Housed-restrained-spring isolators.
8. Pipe-riser resilient supports.
9. Resilient pipe guides.
10. Air-spring isolators.
11. Restrained-air-spring isolators.
12. Elastomeric hangers.
13. Spring hangers.
14. Snubbers.
15. Restraints - rigid type.
16. Restraints - cable type.
17. Restraint accessories.
18. Post-installed concrete anchors.
19. Concrete inserts.
20. Vibration isolation equipment bases.
21. Restrained isolation roof-curb rails.

B. Related Requirements:
1. Section 210548 "Vibration and Seismic Controls for Fire Suppression" for devices for fire-suppression equipment and systems.
2. Section 220548 "Vibration and Seismic Controls for Plumbing" for devices for plumbing equipment and systems.

1.3 DEFINITIONS

A. ASCE/SEI: American Society of Civil Engineers/Structural Engineering Institute

B. IBC: International Building Code.

C. ICC-ES: ICC-Evaluation Service.

D. OSHPD: Office of Statewide Health Planning & Development (for the State of California).

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
   2. Include load rating for each wind-force-restraint fitting and assembly.
   3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic- and wind-force-restraint component.
   4. Annotate types and sizes of seismic restraints and accessories, complete with listing markings or report numbers and load rating in tension and compression as evaluated by an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction.
   5. Annotate to indicate application of each product submitted and compliance with requirements.
   6. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Shop Drawings:
   1. Detail fabrication and assembly of equipment bases.
   2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal:
   1. For each seismic-restraint and wind-load protection device, including seismic-restrained mounting, pipe-riser resilient support, snubber, seismic restraint, seismic-restraint accessory, concrete anchor and insert, and restrained isolation roof-curb rail that is required by this Section or is indicated on Drawings, submit the following:
      a. Seismic and Wind-Load Restraint, and Vibration Isolation Base Selection: Select vibration isolators, seismic and wind-load restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data.
      b. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification by professional engineer that riser system was examined for excessive stress and that none exists.
      c. Concrete Anchors and Inserts: Include calculations showing anticipated seismic and wind loads. Include certification that device is approved by an NRTL for seismic reinforcement use.
      d. Seismic Design Calculations: Submit all input data and loading calculations prepared under "Seismic Design Calculations" Paragraph in "Performance Requirements" Article.

e. Wind-Load Design Calculations: Submit all static and dynamic loading calculations prepared under "Wind-Load Design Calculations" Paragraph in "Performance Requirements" Article.
f. Qualified Professional Engineer: All designated-design submittals for seismic- and wind-restraint calculations are to be signed and sealed by qualified professional engineer responsible for their preparation.

2. Seismic- and Wind-Restraint Detail Drawing:
   a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.
   b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
   c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply also with requirements in other Sections for equipment mounted outdoors.
3. All delegated-design submittals for seismic- and wind-restraint detail Drawings are to be signed and sealed by qualified professional engineer responsible for their preparation.
4. Product Listing, Preapproval, and Evaluation Documentation: By an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and basis for approval (tests or calculations).
5. Design Calculations for Vibration Isolation Devices: Calculate static and dynamic loading due to equipment weight and operating forces required to select proper vibration isolators, and to design vibration isolation bases.
6. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, and spring deflection changes. Include certification that riser system was examined for excessive stress and that none exists.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer and testing agency.

B. Welding certificates.

C. Field quality-control reports.

D. Seismic Qualification Data: Provide special certification for designated seismic systems as indicated in ASCE/SEI 7 Paragraph 13.2.2, "Special Certification Requirements for Designated Seismic Systems" for all Designated Seismic Systems identified as such on Drawings or in the Specifications.
   1. Provide equipment manufacturer's written certification for each designated active mechanical seismic device and system, stating that it will remain operable following the design earthquake. Certification must be based on requirements of ASCE/SEI 7 and AHRI 1270, including shake table testing per ICC-ES AC156 or a similar nationally recognized testing standard procedure acceptable to authorities having jurisdiction or experience data as permitted by ASCE/SEI 7.

2. Provide equipment manufacturer's written certification that components with hazardous contents maintain containment following the design earthquake by methods required in ASCE/SEI 7.
3. Submit evidence demonstrating compliance with these requirements for approval to authorities having jurisdiction after review and acceptance by a licensed professional engineer.

E. Wind-Force Performance Certification: Provide special certification for HVAC components subject to high wind exposure and impact damage and designated on Drawings or in the Specifications to require wind-force performance certification.
1. Provide equipment manufacturer's written certification for each designated HVAC device, stating that it will remain in place and operable following the design wind event and comply with all requirements of authorities having jurisdiction.
2. Provide manufacturer's written certification for each designated louver, damper, or similar device, stating that it will remain in place and protect opening from penetration of windborne debris and comply with all requirements of authorities having jurisdiction.
3. Certification must be based on ICC-ES or similar nationally recognized testing standard procedures acceptable to authorities having jurisdiction.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-spring isolators and restrained-air-spring isolators to include in operation and maintenance manuals.

B. Manufacturer's Inspection Report: Contractor shall submit factory-authorized service representative's final report indicating all restraints and isolation devices as being properly installed or requiring correction.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct testing indicated, be an NRTL as defined by OSHA in 29 CFR 1910.7, and be acceptable to authorities having jurisdiction.

B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Seismic- and Wind-Load-Restraint Device Load Ratings: Devices to be tested and rated in accordance with applicable code requirements and authorities having jurisdiction. Devices to be listed by a nationally recognized third party that requires periodic follow-up inspections and has a listing directory available to the public. Provide third-party listing by one or more of the following: an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.

1.8 COORDINATION

A. Coordinate with vibration isolation restraint manufacturer and the structural contractor/engineer of record to locate and size structural supports underneath vibration isolated restrained equipment (e.g. roof curbs, cooling towers, chillers and other similar equipment).

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic and wind- load control system.
   1. Seismic and Wind-Load Performance: Equipment shall withstand the effects of earthquake motions and high wind events determined in accordance with ASCE/SEI 7.

B. Seismic Design Calculations:
   1. Perform calculations to obtain force information necessary to properly select seismic-restraint devices, fasteners, and anchorage. Perform calculations using methods acceptable to applicable code authorities and as presented in ASCE/SEI 7. Where "ASCE/SEI 7" is used throughout this Section, it is to be understood that the edition referred to is the currently adopted edition.
      a. Data indicated below to be determined by Delegated-Design Contractor must be obtained by Contractor and must be included in individual component submittal packages.
      b. Coordinate seismic design calculations with wind-load calculations for equipment mounted outdoors. Comply with requirements in other Sections in addition to those in this Section for equipment mounted outdoors.
      c. Refer to structural drawings for seismic information and factors.

C. Wind-Load Design Calculations:
   1. Perform calculations to obtain force information necessary to properly select wind-load-restraint devices, fasteners, and anchorage. Perform calculations using methods acceptable to applicable code authorities and as presented in ASCE/SEI 7. Where "ASCE/SEI 7" is used throughout this Section, it is to be understood that the edition referred to is the currently adopted edition.
      a. Data indicated below that are specific to individual pieces of equipment must be obtained by Contractor and must be included in individual component submittal packages.
      b. Coordinate design wind-load calculations with seismic load calculations for equipment requiring both seismic and wind-load reinforcement. Comply with requirements in other Sections in addition to those in this Section for equipment mounted outdoors.
      c. Refer to structural drawings for wind loading information and factors.

D. Fire/Smoke Resistance: Seismic- and wind-load-restraint devices that are not constructed of ferrous metals must have a maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by an NRTL in accordance with ASTM E84 or UL 723, and be so labeled.

E. Component Supports:
1. Load ratings, features, and applications of all reinforcement components must be based on testing standards of a nationally recognized testing agency.
2. All component support attachments must comply with force and displacement resistance requirements of ASCE/SEI 7.

2.2 GENERAL

A. Select vibration isolating units for the lowest operating speed of equipment, so designed that natural frequency of equipment and base mass is not less than 1.5 times the lowest operating frequency of the moving equipment, but not a multiple or harmonic of the base frequency. Furnish vibration isolation producing a uniform loading and deflection even when equipment weight is not evenly distributed, vibration isolation shall be stable during starting and stopping of equipment without excessive traverse and eccentric movement of equipment.

B. The installed vibration isolation system for each floor or ceiling mounted item of equipment shall have a maximum lateral motion under equipment start up and shut down conditions of 1/4 inch. Motions in excess shall be restrained by approved spring type mounting.

C. The type of isolation, base, and minimum static deflection shall be as required for each specific equipment application, but not less than that specified herein when supported on a solid concrete structural slab having a thickness of not less than four (4) inches.
1. Should vibration isolators installed for the equipment prove inadequate to prevent transmission of equipment vibrations to the building structure or limit equipment vibration originated noise in the building spaces to acceptable levels, the isolators shall be replaced with units having the largest deflection that can be practicably installed.

D. All springs installed out-of-doors shall be cadmium-plated, zinc electroplated or powder-coated after fabrication. Hardware and other metal parts shall be cadmium-plated or galvanized. Galvanizing shall meet ASTM Salt Spray Test Standards and Federal Test Standard No. 14.

E. All isolators installed out-of-doors shall have base plates with bolt holes for fastening the isolators to the support members.

2.3 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. California Dynamics Corporation
b. Isolation Technology, Inc
c. Kinetics Noise Control, Inc.
d. Mason Industries, Inc.
e. The VMC Group
f. Vibration Eliminator Co., Inc.
g. Vibration Isolation Co., Inc.
h. Vibration Mountings & Controls/Korfund.
i. Vibro-Acoustics, Inc.

2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
    a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    b. Top plate with threaded mounting holes.
    c. Internal leveling bolt that acts as blocking during installation.
3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.4 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        a. California Dynamics Corporation
        b. Isolation Technology, Inc
        c. Kinetics Noise Control, Inc.
        d. Mason Industries, Inc.
        e. The VMC Group
        f. Vibration Eliminator Co., Inc.
        g. Vibration Isolation Co., Inc.
        h. Vibration Mountings & Controls/Korfund.
        i. Vibro-Acoustics, Inc.
    2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
    3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
    4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
    5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
    6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
    7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
    8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod (where required).
    9. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.5 SNUBBERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Kinetics Noise Control, Inc
   2. Mason Industries, Inc.
   3. Novia; A Division of C&P
   4. Vibration Mountings & Controls, Inc

B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
   1. Post-Installed Concrete Anchor Bolts: Secure to concrete surface with post-installed concrete anchors. Anchors to be seismically prequalified in accordance with ACI 355.2 testing and designated in accordance with ACI 318.
   2. Preset Concrete Inserts: Seismically prequalified in accordance with ICC-ES AC446 testing.
   3. Anchors in Masonry: Design in accordance with TMS 402.
   4. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
   5. Resilient Cushion: Maximum 1/4-inch air gap, and minimum 1/4 inch thick.

2.6 RESTRAINTS - RIGID TYPE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. B-line, an Eaton business
   2. California Dynamics Corporation
   3. Hilti, Inc.
   4. Mason Industries, Inc.
   5. Unistrut; Part of Atkore International

B. Description: Shop- or field-fabricated bracing assembly made of AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53/A53M steel pipe as per NFPA 13, or other rigid steel brace member. Includes accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.7 RESTRAINTS - CABLE TYPE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Gripple Inc.
   2. Kinetics Noise Control, Inc.
   3. Mason Industries, Inc.
   4. Novia; A Division of C&P
   5. Vibration & Seismic Technologies, LLC
   6. Vibration Mountings & Controls, Inc.

B. Seismic-Restraint Cables: ASTM A603 galvanized-steel or ASTM A492 stainless steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for seismic-restraining cable service; with fittings attached by means of poured socket, swaged socket or mechanical (Flemish eye) loop.

C. Restraint cable assembly with cable fittings must comply with ASCE/SEI 19. All cable fittings and complete cable assembly must maintain the minimum cable breaking force. U-shaped cable clips and wedge-type end fittings do not comply and are unacceptable.

2.8 RESTRAINT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. B-line, an Eaton business
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.
4. Novia; A Division of C&P
5. TOLCO
6. Vibration & Seismic Technologies, LLC

B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.9 POST-INSTALLED CONCRETE ANCHORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. B-line, an Eaton business
2. Hilti, Inc.
3. Mason Industries, Inc.
4. Simpson Strong-Tie Co., Inc.
5. Unistrut; Atkore International.

B. Mechanical Anchor Bolts:

1. Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength for anchor and as tested according to ASTM E488/E488M.

C. Adhesive Anchor Bolts:
1. Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488/E488M.

D. Provide post-installed concrete anchors that have been prequalified for use in wind-load applications. Post-installed concrete anchors must comply with all requirements of ASCE/SEI 7, Ch. 13.
1. Prequalify post-installed anchors in concrete in accordance with ACI 355.2 or other approved qualification testing procedures.
2. Prequalify post-installed anchors in masonry in accordance with approved qualification procedures.

2.10 CONCRETE INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. B-line, an Eaton business
2. Hilti, Inc.
3. Mason Industries, Inc.
4. Simpson Strong-Tie Co., Inc.
5. Unistrut; Atkore International.

B. Provide preset concrete inserts that are seismically prequalified in accordance with ICC-ES AC466 testing.

C. Comply with ANSI/MSS SP-58.

2.11 VIBRATION ISOLATION EQUIPMENT BASES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. California Dynamics Corporation
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.
4. Novia; A Division of C&P
5. The VMC Group
6. Vibration Eliminator Co., Inc
7. Vibration Isolation
8. Vibration Mountings & Controls, Inc

B. Steel Rails: Factory-fabricated, welded, structural-steel rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.
   a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Rails shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.
   1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
      a. Include supports for suction and discharge elbows for pumps.

   2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.
   3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

D. Concrete Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
   1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
      a. Include supports for suction and discharge elbows for pumps.
   2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
   3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
   4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.12 RESTRAINED ISOLATION ROOF-CURB RAILS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. California Dynamics Corporation
   2. Kinetics Noise Control, Inc.
   3. Mason Industries, Inc.
   4. Novia; A Division of C&P
   5. The VMC Group
   6. Thybar Corporation

B. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand seismic and wind forces.

C. Upper Frame: The upper frame shall provide continuous support for equipment and shall be captive to resiliently resist seismic and wind forces.

D. Lower Support Assembly: The lower support assembly shall be formed sheet metal section containing adjustable and removable steel springs that support the upper frame. The lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly. Adjustable, restrained-spring isolators shall be mounted on elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.

E. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.

F. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

G. Acoustical Barrier: The floating member of the roof curb shall have a perimeter angle cross members to support two layers of 5/8" waterproof sheetrock laid on with staggered joints. Sheetrock must surround ducts to provide a continuous sound break. This acoustical barrier shall be caulked to minimize sound transmission between the rooftop air handling unit and the building. Where the mechanical arrangement makes attachment to the floating member unfeasible, the barrier shall be attached at the highest practical elevation of the fixed curb with provision for 1" thick closed cell neoprene flexible seals around any ductwork. A 4-inch layer of 1.5 density fiberglass shall cover the entire solid roof surface under the unit. Ductwork shall be externally lined with sound absorbent material coated with a dampening compound such as Mason Industries MDC-10 or approved equal. Complete instructions shall be provided by the spring isolation curb manufacturer. Acoustical package shall be Mason Industries, Inc. Type RSC-dB or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic- and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

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

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static, wind load, and seismic loads within specified loading limits.

3.3 INSTALLATION OF VIBRATION-CONTROL, WIND-LOAD CONTROL, AND SEISMIC-RESTRAINT DEVICES

A. Provide vibration-control devices for systems and equipment where indicated in Equipment Schedules or Vibration-Control Devices Schedules, where indicated on Drawings, or where Specifications indicate they are to be installed on specific equipment and systems.

B. Provide seismic-restraint and wind-load control devices for systems and equipment where indicated in Equipment Schedules or Seismic-Restraint Devices Schedules, where indicated on Drawings, where Specifications indicate they are to be installed on specific equipment and systems, and where required by applicable codes.

C. Housekeeping Pads:
   1. All floor-mounted equipment shall be set on concrete housekeeping pads designed by the seismic engineer to meet the specific seismic requirements of each piece of floor mounted equipment.
   2. Housekeeping pads shall rest on a structural floor and be constructed per the details provided by the seismic engineer.
   3. Housekeeping pad shall be constructed as one continuous monolithic pour. Forms shall be constructed to allow removal after concrete pour without prying against pad.

D. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

E. Installation of vibration isolators, wind-load restraints, must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

F. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

G. Equipment Restraints:
   1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.

2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install seismic-restraint, and wind-load-restraint devices using methods approved by an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction that provides required submittals for component.

H. Piping Restraints:
1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

I. Install seismic- and wind-load-restraint cables so they do not bend across edges of adjacent equipment or building structure.

J. Equipment Bases:
1. Fill concrete inertia bases, after installing base frame, with 3000-psi concrete; trowel to a smooth finish.
   a. Cast-in-place concrete materials and placement requirements are specified in Division 3.
2. Concrete Bases: Anchor equipment to concrete base according to supported equipment manufacturer's written instructions for seismic codes at Project site.
   a. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
   b. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base and anchor into structural concrete floor.
   c. Place and secure anchorage devices. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   d. Install anchor bolts to elevations required for proper attachment to supported equipment.
   e. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
   f. Cast-in-place concrete materials and placement requirements are specified in Division 3.

K. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction that provides required submittals for component.

L. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

M. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

N. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

O. Mechanical Anchor Bolts:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge-Type Anchor Bolts: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive-Type Anchor Bolts: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Provide flexible connections in piping systems where they cross structural seismic joints, expansion joints and other point where differential movement may occur. Provide adequate flexibility to accommodate differential movement as determined in accordance with ASCE/SEI 7. Comply with requirements in other sections for piping flexible connections.

3.5 INSTALLATION OF VIBRATION ISOLATION EQUIPMENT BASES

A. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

B. Coordinate dimensions of steel equipment rails and bases, concrete inertia bases, and restrained isolation roof-curb rails with requirements of isolated equipment specified in this and other Sections. Where dimensions of these bases are indicated on Drawings, dimensions may require adjustment to accommodate actual isolated equipment.

3.6 ADJUSTING

A. Adjust isolators after system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

3.7 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. Tests and Inspections:
   1. Perform tests and inspections with the assistance of a factory-authorized service representative.
   2. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
   3. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
   4. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
   5. Test no fewer than four of each type and size of installed anchors and fasteners selected by Architect.
   6. Test to 90 percent of rated proof load of device.
   7. Measure isolator restraint clearance.
   8. Measure isolator deflection.
   9. Verify snubber minimum clearances.

C. Remove and replace malfunctioning units and retest as specified above.

D. Units will be considered defective if they do not pass tests and inspections.

E. Prepare testing agency test and inspection reports.

F. Manufacturer's Inspection:
   1. A representative of the isolation materials manufacturer shall inspect the completed system and report in writing any installation errors, improperly selected isolation or restraint devices, or other faults that could affect the performance of the system.
   2. Contractor shall submit manufacturer's representative's final report indicating all isolation as being properly installed or requiring correction. If corrections are required, include steps to be taken to properly complete the isolation work.

3.8 VIBRATION ISOLATION AND SEISMIC-RESTRAINT SCHEDULE

A. Rooftop Air-Handling Units:
   1. Isolation Type: Restrained Isolation Roof-Curb
   2. Base Deflection: 1.5"

B. Fans in Air-Handling Units:
   1. Isolation Type: Restrained-Spring Isolator
   2. Base Deflection: 1.5"
   3. Base Type: Concrete Inertia Base.
   4. Remarks: Thrust Restraints.

C. Roof Mounted Fans:

1. Isolation Type: Restrained Isolation Roof-Curb Rail
2. Base Deflection: 1.5"

D. Suspended Fan Coil Units:
1. Isolation Type: Spring Hanger
2. Deflection: 0.5"

E. Air-Cooled Condensers and Condensing Units (On Roof):
1. Isolation Type: Restrained Isolation Roof-Curb Rail
2. Deflection: 1.5"

F. First Four (4) Pipe Hangers near Isolated Equipment:
1. Isolation Type: Spring Hanger
2. Deflection:
   a. Piping 3-inches and smaller: 0.75"
   b. Piping 4-inches to 6-inches: 1.5"
   c. Piping Larger than 6-inches: 2.5"

END OF SECTION 230548

SECTION 230550 – VARIABLE FREQUENCY DRIVES

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 separately enclosed, preassembled, combination VFDs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

B. Related Requirements:
1. Section 230513 "Common Motor Requirements for HVAC Equipment."
2. Section 230900 "Building Automation and Temperature Control System."

1.3 SCOPE

A. All pump VFDs, and VFDs for fans not in air handling units, shall be furnished and installed (set in place) by the BAS provider.

B. Air handling unit VFDs shall be furnished and installed by the air handling unit manufacturer.

C. Power wiring for VFDs shall be provided under Division 26.

1.4 DEFINITIONS

A. BAS: Building Automation System.

B. CE: Conformite Europeene (European Compliance).

C. CPT: Control power transformer.

D. EMI: Electromagnetic interference.

E. LCD: Liquid-crystal display.

F. LED: Light-emitting diode.

G. OCPD: Overcurrent protective device.

H. PID: Control action, proportional plus integral plus derivative.

I. RFI: Radio-frequency interference.

J. VFD: Variable-frequency drive.

1.5 ACTION SUBMITTALS

A. Product Data: For each type and rating of VFD indicated.
   1. Include dimensions and finishes for VFDs.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For each VFD indicated.
   1. Include mounting and attachment details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Variable frequency drives shall be included in the development of the Coordination and Installation Drawings, drawn to scale, showing dimensioned layout on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Required working clearances and required area above and around VFDs.
   2. Show VFD layout and relationships between electrical components and adjacent structural and mechanical elements.
   3. Show support locations, type of support, and weight on each support.
   4. Indicate field measurements.

B. Seismic Qualification Data: Certificates, for each VFD, accessories, and components, from manufacturer.
   1. Certificate of compliance.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.

C. Product Certificates: For each VFD from manufacturer.

D. Harmonic Analysis Report: Provide Project-specific calculations and manufacturer's statement of compliance with IEEE 519.

E. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For VFDs 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. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and motor-circuit protector trip settings.
      b. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
      c. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
      d. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.8 DELIVERY, STORAGE, AND HANDLING

A. VFDs should be delivered, stored and handled in a manner that protects them from damage, moisture, dirt and intrusion of foreign materials.

B. Store VFDs indoors in clean, dry space with uniform temperature to prevent condensation. Maximum ambient temperature for storage shall be -40 to 120 degrees Fahrenheit.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace VFDs that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ABB, Inc.
   2. Danfoss Inc.
   3. Yaskawa Electric America, Inc.

2.2 SYSTEM DESCRIPTION

A. General Requirements for VFDs:
   1. VFDs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508A.

B. Application: Variable torque.

C. VFD Description: Variable-frequency motor controller, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.
1. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
2. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

D. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

E. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage (not applicable to fan arrays).
1. For fan arrays, output rating shall match fan array motor selection.

F. Unit Operating Requirements:
1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFD input voltage rating.
2. Input AC Voltage Unbalance: Not exceeding 5 percent.
3. Input Frequency Tolerance: Plus or minus 3 percent of VFD frequency rating.
4. Minimum Efficiency: 96 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 98 percent under any load or speed condition.
6. Minimum Short-Circuit Current (Withstand) Rating: 100 kA.
7. Ambient Temperature Rating: Not less than 32 deg F and not exceeding 104 deg F. Operating up to 122 degF shall be possible with 10 percent de-rating if required.
8. Humidity Rating: Less than 95 percent (noncondensing).
9. Altitude Rating: Not exceeding 3300 feet.
10. Vibration Withstand: Comply with NEMA ICS 61800-2.
11. Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
12. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
13. Output Carrier Frequency: Selectable; 0.5 to 12 kHz.
14. Stop Modes: Programmable; includes fast, free-wheel, and dc coast or ramp to stop.

G. Isolated Control Interface: Allows VFDs to follow remote-control signal over a minimum 4:1 speed range.
1. Signal: Electrical.

H. Internal Adjustability Capabilities:
1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 0.1 to 999.9 seconds.
4. Deceleration: 0.1 to 999.9 seconds.
5. Current Limit: 30 to minimum of 110 percent of maximum rating.

I. Self-Protection and Reliability Features:
   1. Surge Suppression: Factory installed as an integral part of the VFD, complying with UL 1449 SPD, Type 1 or Type 2.
   2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
   3. Under- and overvoltage trips.
   4. Inverter overcurrent trips.
   5. VFD and Motor-Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFDs and motor thermal characteristics, and for providing VFD overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
   6. Critical frequency rejection, with three selectable, adjustable deadbands.
   7. Instantaneous line-to-line and line-to-ground overcurrent trips.
   8. Loss-of-phase protection (drive and bypass mode).
   9. Short-circuit protection.
   10. Motor-overtemperature fault.

J. Automatic Reset/Restart: Attempt five restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.

K. Bidirectional Autospeed Search: Capable of starting VFD into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

L. Integral Input Disconnecting Means and OCPD:
   1. VFDs With a Bypass System:
      a. UL 489, thermal-magnetic circuit breaker with pad-lockable, door-mounted handle mechanism.
      b. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFD input current rating, whichever is larger.
   2. VFDs Without a Bypass System:
      a. NEMA KS 1, fusible switch with pad-lockable, door-mounted handle mechanism.
      b. Disconnect Rating: Not less than 115 percent of VFD input current rating.

2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: VFDs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. The designated VFDs shall be tested and certified by an NRTL as meeting the ICC-ES AC 156 test procedure requirements.
   1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.4 CONTROLS AND INDICATION

A. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
   1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
   2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.
      a. Control Authority: Supports at least four conditions: Off, local manual control at VFD, local automatic control at VFD, and automatic control through a remote source.

B. Historical Logging Information and Displays:
   1. Real-time clock with current time and date and battery backup.
   2. Running log of total power versus time.
   3. Total run time.
   4. Fault log, maintaining last three faults with time and date stamp for each.

C. Indicating Devices: Digital display and additional readout devices as required, mounted flush in VFD door and connected to display VFD parameters including, but not limited to:
   1. Output frequency (Hz).
   2. Motor speed (rpm).
   3. Motor status (running, stop, fault).
   4. Motor current (amperes).
   5. Motor torque (percent).
   6. Fault or alarming status (code).
   7. PID feedback signal (percent).
   8. DC-link voltage (V dc).
   9. Set point frequency (Hz).
   10. Motor output voltage (V ac).

D. Control Signal Interfaces:
   1. Electric Input Signal Interface:
      a. A minimum of two programmable analog inputs: 0- to 10-V dc or 4- to 20-mA dc.
      b. A minimum of six multifunction programmable digital inputs.
   2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BAS system for HVAC or other control systems:
      a. 0- to 10-V dc.
      b. 4- to 20-mA dc.
      c. Fixed frequencies using digital inputs.
   3. Output Signal Interface: A minimum of one programmable analog output signal(s) (0- to 10-V dc or 4- to 20-mA dc), which can be configured for any of the following:
      a. Output frequency (Hz).
      b. Output current (load).
      c. DC-link voltage (V dc).
      d. Motor torque (percent).
      e. Motor speed (rpm).
      f. Set point frequency (Hz).

4. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
   a. Motor running.
   b. Set point speed reached.
   c. Fault and warning indication (overtemperature or overcurrent).
   d. PID high- or low-speed limits reached.

E. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.
   1. Number of Loops: Two.

F. Interface with BAS System for HVAC: Factory-installed hardware and software shall interface with BAS system for HVAC to monitor, control, display, and record data for use in processing reports. VFD settings shall be retained within VFD's nonvolatile memory.
   1. Hardwired Points:
      a. Monitoring: On-off status.
      b. Control: On-off operation.
   2. Communication Interface: The standard protocols shall be Modbus, Johnson Controls N2, Siemens Building Technologies FLN, and BACnet. Communication shall interface with BAS system for remotely control and monitor from an operator workstation. Control features and monitoring points displayed locally at control panel shall be available through the BAS system and mapped to graphical user interfaces.

2.5 LINE CONDITIONING AND FILTERING

A. Input Line Conditioning: Based on the manufacturer's harmonic analysis study and report, provide input filtering to limit total demand (harmonic current) distortion and total harmonic voltage demand at the defined point of common coupling to meet IEEE 519 recommendations. Provide minimum 5 percent impedance AC line reactor or DC bus chokes of equivalent impedance.

B. Output Filtering: For separation between motor and VFD of greater than 100 feet, provide dV/dT filters.

C. EMI/RFI Filtering: CE marked; certify compliance with IEC 61800-3 for the First Environment restricted level (Category C2).

2.6 BYPASS SYSTEMS

A. Bypass Operation: Safely transfers motor between power converter output and bypass circuit, manually, automatically, or both. Selector switches set modes and indicator lights indicate mode selected. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter.

B. Bypass Mode: Field-selectable automatic or manual, allows local and remote transfer between power converter and bypass contactor and retransfer, either via manual operator interface or automatic-control system feedback.

C. Bypass Controller: Two-contactor-style full-voltage (across-the-line) type bypass allows motor operation via the power converter or the bypass controller; with input isolating switch and arranged to isolate the power converter and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.
   1. Bypass Contactor: Load-break, IEC-rated contactor.
   2. Output Isolating Contactor: Non-load-break, IEC-rated contactor.
   3. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.

2.7 OPTIONAL FEATURES

A. Multiple-Motor Capability: VFD suitable for variable-speed service to multiple motors. Overload protection shuts down VFD and motors served by it, and generates fault indications when overload protection activates.
   1. Configure to allow two or more motors to operate simultaneously at the same speed; separate overload relay for each controlled motor.

B. Damper control circuit with end-of-travel feedback capability.

C. Firefighter's Override (Smoke Purge) Input: On a remote contact closure from the firefighter's control station or smoke-control fan controller, this password-protected input:
   1. Overrides all other local and external inputs (analog/digital, serial communication, and all keypad commands).
   2. VFDs Without a Bypass System: Forces VFD to operate motor, without any other run or speed command, at a field-adjustable, preset speed.
      a. Final speed setting to be determined during commissioning, testing, and balancing of the ventilation system.
   3. VFDs With a Bypass System: Forces VFD to transfer to bypass mode and operate motor at full speed.
   4. Causes display of override mode on the VFD display.
   5. Reset VFD to normal operation on removal of override signal automatically.

D. Communication Port: RJ-45 port.

2.8 ENCLOSURES

A. VFD Enclosures: NEMA 250, to comply with environmental conditions at installed location.
   1. Dry and Clean Indoor Locations: Type 1.
   2. Mechanical Rooms and Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12:
   3. Outdoor Locations: Type 4X.
   4. Wash-Down Areas: Type 4X, stainless steel.
   5. Other Wet or Damp Indoor Locations: Type 4.

B. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFD as "Plenum Rated."

2.9 ACCESSORIES

A. Phase-Failure: Solid-state sensing circuit with isolated output contacts for hard-wired connections.

B. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

C. Programming Tools: To support the drive's life cycle from startup and monitoring, to backup, and performance tuning.

2.10 SOURCE QUALITY CONTROL

A. Testing: Test and inspect VFDs according to manufacturers' standard procedures and in accordance with ISO 9001, latest revision.
   1. Test each VFD while connected to a full motor load that is comparable to that for which the VFD is rated, at rated drive amperes at 105 degrees Fahrenheit in a temperature chamber.
   2. Verification of Performance: Rate VFDs according to operation of functions and features specified.

B. VFDs will be considered defective if they do not pass tests and inspections.

C. Test and inspection reports shall be available upon request.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFDs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.

B. Examine VFD before installation. Reject VFDs that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFD installation.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work

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

3.2 INSTALLATION

A. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks.

B. Roof-Mounting Controllers: Install VFD on roofs with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished roof surface unless otherwise indicated, and by bolting units to curbs or mounting on freestanding, lightweight, structural-steel channels bolted to curbs. Seal roof penetrations after raceways are installed.

C. Seismic Bracing: Comply with requirements specified in Section 260548 "Seismic Controls for Electrical Systems."

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Comply with NECA 1.

F. Controllers shall be located so that door can be fully opened without interference.

3.3 IDENTIFICATION

A. Identify VFDs, components, and control wiring. Comply with requirements for identification specified in Section 230553 "Identification for HVAC Piping and Equipment."
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each VFD with engraved nameplate.
   3. Label each enclosure-mounted control and pilot device.

3.4 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. Acceptance Testing Preparation:
   1. Test insulation resistance for each VFD element, bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

C. Tests and Inspections:
   1. Inspect VFD, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
   2. Test insulation resistance for each VFD element, component, connecting motor supply, feeder, and control circuits.
   3. Test continuity of each circuit.

4. Verify that voltages at VFD locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform tests according to the Inspection and Test Procedures for Adjustable Speed Drives stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. VFDs will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies the VFD and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.

3.6 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Adjust the trip settings of instantaneous-only circuit breakers and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to 6 times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed 8 times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Architect before increasing settings.

D. Set field-adjustable circuit-breaker trip ranges.

E. Set field-adjustable pressure switches.

F. All field adjustments shall be recorded and kept in cabinet with drawings.

3.7 STORAGE AND PROTECTION

A. Replace VFDs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFDs.

END OF SECTION 230550

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Warning tape.
4. Pipe labels.
5. Duct labels.
6. Stencils.
7. Valve tags.
8. Underground Warning Labels.
9. Warning tags.

1.3 ACTION 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. Pipe Label Schedule: Include a listing of all piping to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals. Include Service Abbreviation, Number Sequence, Valve Location and Valve Function.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brady Corporation
   b. Brimar Industries, Inc.
   c. Carlton Industries, LP
   d. Craftmark Pipe Markers
   e. Kolbi Pipe Marker Co.
   f. LEM Products Inc.
   g. Seton Identification Products
2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
3. Letter Color: White.
4. Background Color: Black.
5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
6. Minimum Label Size: Length and width vary for required label content, but not less than 4 by 2-1/2 inch.
7. Minimum Letter Size: 3/4 inch.
8. Fasteners: Stainless-steel rivets or self-tapping screws, or double face adhesive.
9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Equipment Markers: Engraved phenolic plastic nameplates with 3/4-inch white surface and 1/4-inch tall black lettering.
   1. Fasteners: Epoxy.

C. Label Content: Include equipment's Drawing designation or unique equipment number as indicated on the mechanical drawings and schedules.

2.2 WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Brady Corporation
   2. Brimar Industries, Inc.
   3. Carlton Industries, LP
   4. Craftmark Pipe Markers
   5. Kolbi Pipe Marker Co.
   6. LEM Products Inc.
   7. Seton Identification Products

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Maximum Temperature: Able to withstand temperatures of 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 of 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-taping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA70E and other applicable codes and standards.

J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 WARNING TAPE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Brady Corporation
2. Brimar Industries, Inc.
3. Carlton Industries, LP
4. Craftmark Pipe Markers
5. Kolbi Pipe Marker Co.
6. LEM Products Inc.
7. Seton Identification Products

B. Material: Vinyl.

C. Minimum Thickness: 0.005 inch.

D. Letter, Pattern, and Background Color: As indicated for specific application under Part 3.

E. Waterproof Adhesive Backing: Suitable for indoor or outdoor use.

F. Maximum Temperature: 160 deg F.

G. Minimum Width: 4 inches.

2.4 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Brady Corporation
2. Brimar Industries, Inc.
3. Carlton Industries, LP
4. Craftmark Pipe Markers

5. Kolbi Pipe Marker Co.
6. LEM Products Inc.
7. Seton Identification Products

B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

F. 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. Pipe size.
2. Flow-Direction Arrows: Include flow-direction arrows on distribution piping. Arrows may be either integral with label or applied separately.
3. Lettering Size: [Size letters in accordance with ASME A13.1 for piping.

2.5 DUCT LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Brady Corporation
2. Brimar Industries, Inc.
3. Carlton Industries, LP
4. Craftmark Pipe Markers
5. Kolbi Pipe Marker Co.
6. LEM Products Inc.
7. Seton Identification Products

B. Self-Adhesive Labels: Printed vinyl plastic with contact-type, permanent-adhesive backing.
1. Ducts up to 24": Minimum of 2-1/2" x 16" and has a letter size of 1-1/2".
2. Ducts Larger than 24": Minimum of 4" x 24" and has a letter height of 2-1/2".

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

F. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings. Also include the following:
1. Duct size.
2. Flow-Direction Arrows: Include flow-direction arrows on distribution ducts. Arrows may be either integral with label or may be applied separately.

3. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

2.6 STENCILS

A. Stencils for Ducts:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Brimar Industries, Inc.
      b. Carlton Industries, LP
      c. Champion America
      d. Craftmark Pipe Markers
      e. Kolbi Pipe Marker Co.
      f. Marking Sevices Inc.
   2. Lettering Size:
      a. Ducts up to 24": 1-1/2".
      b. Ducts Larger than 24": 2-1/2".
   3. Stencil Material: Fiberboard or metal.
   4. Stencil Paint: Exterior, gloss, Enamel. Paint may be in pressurized spray-can form.
   5. Identification Paint: Exterior, Enamel. Paint may be in pressurized spray-can form.
   6. Letter and Background Color: Color as indicated for specific application under Part 3.

2.7 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Brady Corporation
   2. Brimar Industries, Inc.
   3. Carlton Industries, LP
   4. Craftmark Pipe Markers
   5. Kolbi Pipe Marker Co.
   6. LEM Products Inc.
   7. Seton Identification Products

B. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
   1. Tag Material: Brass, 0.04-inch or anodized aluminum, 0.031-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
   2. Fasteners: Brass link chain or beaded chain.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
   1. Include valve-tag schedule in operation and maintenance data..

2.8 UNDERGROUND PIPE WARNING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Brady Corporation
   2. Brimar Industries, Inc.
   3. Carlton Industries, LP
   4. Craftmark Pipe Markers
   5. Kolbi Pipe Marker Co.
   6. LEM Products Inc.
   7. Seton Identification Products

B. Description: Preprinted detectable underground tape of B-721 metal detectable polyester material with subsurface graphics to seal the legend from acids, alkalis and other destructive soil substances.
   1. Size: Minimum 5 mils thick, 4 inches wide with minimum tensile strength of 120 lbs.
   2. Nomenclature: Utilize manufactures standard legends to identify underground piping. Provide a continuous printed message similar to "Caution Water Line Buried Below"
   3. Color: Utilize manufactures standard colors.

2.9 WARNING TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Brady Corporation
   2. Brimar Industries, Inc.
   3. Carlton Industries, LP
   4. Craftmark Pipe Markers
   5. Kolbi Pipe Marker Co.
   6. LEM Products Inc.
   7. Seton Identification Products

B. 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: Brass grommet and wire.
   3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
   4. Color: Safety yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

A. Permanently fasten labels on each item of mechanical equipment.

B. Sign and Label Colors:
   1. White letters on an ANSI Z535.1 safety-blue background.

C. Locate equipment labels where accessible and visible.

D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where arc-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.

E. For equipment located above the ceiling, in addition to a label on the equipment, labels are to be permanently affixed to the ceiling grid framing as near to the item as possible using epoxy glue. Where hard ceilings are used, the label is to be affixed to the frame of the access panel for the unit.
   1. The thermostat that controls each piece of equipment shall be identified with an identical but appropriately sized label.

F. For fire, smoke and fire/smoke dampers located above the ceiling, labels having letters not less than 0.5 inch in height are to be permanently affixed to the ceiling grid or framing as near to the item as possible using epoxy glue. Where hard ceilings are used, the label is to be affixed to the frame of the access panel providing access above ceiling.
   1. Label text shall be: FIRE/SMOKE DAMPER, SMOKE DAMPER or FIRE DAMPER.

3.4 PIPE COLOR CODING

A. Paint exposed and insulated piping in finished areas and mechanical rooms.
   1. Finished Areas: Color shall be the same as the adjacent surface. Color by Architect.
   2. Mechanical Rooms: Color shall be the same as the pipe label background color.
   3. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
   4. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Exterior non-insulated piping shall be painted with two coats of rust inhibitive paint. Colors shall be approved by the Owner after a sample is provided for each service. Do not paint aluminum jackets.

C. Do not paint exposed copper piping or galvanized piping.

D. Do not paint aluminum or stainless-steel jackets.

E. Painting of piping is specified in Division 09.

3.5 INSTALLATION OF PIPE LABELS

A. Install pipe labels showing service and flow direction with permanent adhesive on pipes.

B. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Within 3 ft. of each valve and control device.
2. At access doors, manholes, and similar access points that permit view of concealed piping.
3. Within 3 ft. of equipment items and other points of origination and termination.
4. Within 3 ft. above and below every floor penetration and on either side of every wall penetration.
5. At least one pipe marker per pipe in every room.
6. Spaced at maximum intervals of 20 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping, ductwork, and equipment.

C. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.

D. Flow-Direction Arrows: Use arrows to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

E. Pipe Label Color Schedule:
1. Air Conditioning Condensate Piping:
   a. Background: Safety green.
   b. Letter Colors: White.
   c. Designation: AC CONDENSATE
2. Refrigerant Piping:
   a. Background: Safety black.
   b. Letter Colors: White.
   c. Designation: REFRIGERANT GAS. REFRIGERANT LIQUID

3.6 INSTALLATION OF DUCT LABELS

A. Install self-adhesive duct labels showing service and flow direction with permanent adhesive on air ducts.

1. Provide labels in the following color codes:
   a. For outside-air and supply-air ducts: White letters on blue background.
   b. For relief-air and return-air ducts: White letters on green background.
   c. For exhaust-air ducts: White letters on yellow background.

B. Stenciled Duct-Label Option: Stenciled labels showing service and flow direction may be provided instead of plastic-laminated duct labels, at Installer's option.

C. Locate label near each point where ducts enter into and exit from concealed spaces and at maximum intervals of 20 ft. where exposed or are concealed by removable ceiling system.

3.7 INSTALLATION OF VALVE TAGS

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule in the operating and maintenance manual.

B. Ceiling valve markers shall be provided for valves above ceilings. Attach valve marker to ceiling grid directly below the valve.

3.8 UNDERGROUND PIPE WARNING

A. Provide continuous underground pipe marking tape above all HVAC pipes buried beneath the ground.

B. Provide a continuous length of tape 6" below the finished earth surface directly above the buried pipe.

C. Provide a second continuous length of tape 12" above the top of the buried pipe if the top of the pipe is lower than 36" from the top of the finished earth surface.

D. If tape cannot be continuous then it must overlap by ten feet at any end.

3.9 INSTALLATION OF WARNING TAGS

A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background.

B. Attach warning tags, with proper message, to equipment and other items where indicated on Drawings, scheduled or required.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Testing, Adjusting, and Balancing of Air Systems:
      a. Constant-volume air systems.
      b. Variable-air-volume systems.
      c. Multizone systems.
   2. Testing, adjusting, and balancing of equipment.
   3. Procedures for exhaust hoods.
   4. Duct leakage tests verification.
   5. Indoor-air quality measuring.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

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

E. TDH: Total dynamic head.

F. UFAD: Underfloor air distribution.

1.4 INFORMATIONAL SUBMITTALS

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

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 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 30 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.

G. Sample report forms.

H. Instrument calibration reports, to include the following:
1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 QUALITY ASSURANCE

A. TAB Specialists Qualifications, Certified by AABC or NEBB:
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.

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. Code and AHJ Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

1.6 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, BAS provider, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Coordinate efforts with the project Commissioning Agent. Refer to commissioning specifications for additional information.

C. Provide seven days' advance notice for each test. Include scheduled test dates and times.

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

1.7 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.

1.8 WARRANTY

A. Performance Warranty:
   1. If AABC standards are used, provide a warranty on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents.
   2. If NEBB standards are used, provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents.

B. Warranty includes the following provisions:
   1. The certified TAB firm 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 TAB SPECIALISTS

A. Subject to compliance with requirements, available TAB specialists that may be engaged include, but are not limited to, the following:
   1. Carolina Air & Water Balancing Company, Inc.
   2. Hall Technology, Inc.
   3. KLG Jones, LLC.
   4. Palmetto Air & Water Balance, Inc.

3.2 EXAMINATION

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

B. Examine installed systems for balancing devices, such as test ports, gauge 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 HVAC to verify that they are properly separated from adjacent areas and sealed.

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 temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainer baskets are installed and clean.

L. Examine AHU, boiler and terminal unit by-pass piping used for water treatment flushing. Verify that valves in flushing bypass piping are fully closed.

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

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

O. Examine system pumps to ensure absence of entrained air in the suction piping.

P. Examine operating safety interlocks and controls on HVAC equipment.

Q. Examine control dampers for proper installation for their intended function of isolating, throttling, diverting, or mixing air flows.

R. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

A. Prepare a TAB plan that includes 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.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system in accordance with the procedures contained in ASHRAE 111 or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

B. Cut insulation, ducts, pipes, and equipment casings 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. Where holes for probes are required in piping or hydronic equipment, install pressure and temperature test plugs to seal systems.

3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 230700 "HVAC Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.5 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT

A. Test, adjust, and balance HVAC equipment indicated on Drawings, including, but not limited to, the following:
1. Motors.
2. Fans and ventilators.
3. Terminal units.
4. Commercial kitchen hoods.
5. Unit heaters.
6. Heat exchangers.
7. Condensing units.
8. Air-handling units.
9. Split-system air conditioners.
10. Coils.
11. Fan coil units.

3.6 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' Record drawings 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."

3.7 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 main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
      c. Where duct conditions are unsuitable 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 Contractor-prepared shop drawings and Record drawings 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, speed, 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.

3.8 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:
1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
2. Verify that the system is under static pressure control.
3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:
    a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
    b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
    c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
    d. Adjust controls so that terminal is calling for minimum airflow.
    e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
    f. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.
5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.
    a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow, so that connected total matches fan selection and simulates actual load in the building.

c. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
d. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

6. 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 any artificial loading of filters at the time static pressures are measured.
7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
   a. Balance the return-air ducts and inlets.
   b. Verify that terminal units are meeting design airflow under system maximum flow.
8. Re-measure the inlet static pressure at the most critical terminal unit, and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls Contractor.
9. Verify final system conditions as follows:
   a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
   b. Re-measure and confirm that total airflow is within design.
   c. Re-measure final fan operating data, speed, volts, amps, and static profile.
   d. Mark final settings.
   e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
   f. Verify tracking between supply and return fans.

3.9 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.

3.10 PROCEDURES FOR AIR-COOLED CONDENSING UNITS

A. Verify proper rotation of fan(s).

B. Measure and record entering- and leaving-air temperatures.

C. Measure and record entering and leaving refrigerant pressures.

D. Measure and record operating data of compressor(s), fan(s), and motors.

3.11 PROCEDURES FOR EXHAUST HOODS

A. Room Pressure: Measure and record room pressure with respect to atmosphere and adjacent space with hoods in room initially not operating and then with hoods operating.

B. Makeup Air: Systems supplying source of makeup air to hoods shall be in operation during testing and balancing of exhaust hoods.
   1. Measure and record temperature of makeup air entering hood. If hood makeup air is from multiple sources having different temperatures, measure and record the airflow and temperatures of each source and calculate the weighted average temperature.
   2. Use simulated smoke to observe supply air-distribution air patterns in vicinity of hoods. Consult with hood manufacturer and report conditions that have a detrimental effect on intended capture, containment, and other attributes effecting proper operation.

C. Rooms with Multiple Hoods: Test each hood separately, one at a time, and repeat tests with all hoods intended to operate simultaneously by design.

D. Kitchen Hoods:
   1. Visually inspect the hood exhaust duct throughout its entire length in compliance with authorities having jurisdiction. Begin at the hood connection and end at the point it discharges outdoors. Report findings.
      a. Check duct slopes as required.
      b. Verify that duct access is installed as required.
      c. Verify that point of termination is as required.
      d. Verify that duct air velocity is within the range required.
      e. Verify that duct is within a fire-rated enclosure.
      f. Report deficiencies.
   2. Type 1: Measure and record pressure drop and face velocity of hood filters and slots in accordance with hood manufacturer's instructions. Consult hood manufacturer to determine hood airflow using recorded information.
   3. Type 2: Measure and record airflow by duct traverse.
   4. Capture and Containment: Check each hood for proper capture and containment using a smoke-emitting device. Observe and report performance. Make adjustments to achieve optimum results.

E. AHJ Tests: Conduct additional tests required by authorities having jurisdiction.

3.12 DUCT LEAKAGE TESTS

A. Witness the duct leakage testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified limits.

C. Report deficiencies observed.

3.13 INDOOR-AIR QUALITY TESTING

A. After construction is complete (including air balancing and final cleaning) and prior to occupancy, with the HVAC systems operating at indicated conditions conduct baseline pre-occupancy indoor air quality testing in accordance with the "Green Globes® for New Construction 2019 Technical Reference Manual", Credit 6.2.2, using testing protocols consistent with:
   1. U.S. EPA's Compendium of Methods for the Determination of Toxic Organic Pollutants in Ambient Air.
   2. EPA TO-1, TO-11, TO-17.
   3. ASTM D 5197-09e1 Standard Test Method for Determination of Formaldehyde and Other Carbonyl Compounds in Air (Active Sampler Methodology).

B. The test protocols shall be in accordance with the following:
   1. All measurements shall be conducted prior to occupancy, but during normal occupied hours, and with the building ventilation system starting at the normal daily start time and operated at the minimum outside air flow rate for the occupied mode throughout the duration of the air testing.
   2. The building shall have all interior finishes installed, including but not limited to millwork, doors, paint, carpet and acoustic tiles. Non-fixed furnishings such as workstations and partitions are encouraged, but not required, to be in place for the testing.
   3. Air sampling and monitoring shall be at a height of 3 feet and 6 feet from the floor to represent the breathing zone of occupants and at least 3 feet away from walls and ventilation supply.
   4. The test protocols shall be documented to show that appropriate sampling methods and times were used.
   5. The number of sampling locations shall be as follows for each portion of the building served by a separate ventilation system
      a. At least one per contiguous floor; and
      b. At least one per 10,000 SF of floor area.
   6. The sampling points shall include areas presumed to have the greatest source strength with the least ventilation.

C. For each location, measure, record and demonstrate that the maximum contaminant concentrations listed in "Green Globes® for New Construction 2019 Technical Reference Manual" Table 11.2.2.1.1 are not exceeded.

D. Submit a copy of the proposed IAQ testing procedures, actual testing locations, and testing results.

3.14 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
   1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
   2. Air Outlets and Inlets: Plus or minus 10 percent.
   3. Heating-Water Flow Rate: Plus or minus 10 percent.
   4. Chilled-Water Flow Rate: Plus 10 percent or minus 0 percent.
   5. Condenser-Water Flow Rate: Plus 10 percent or minus 0 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.15 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 system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance-measuring and -balancing devices.

B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.16 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 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. Heating coil, dry-bulb conditions.
    e. Face and bypass damper settings at coils.
    f. Fan drive settings, including settings and percentage of maximum pitch diameter.
    g. Variable-frequency controller and inlet vane settings for variable-air-volume systems.
    h. Settings for pressure controller(s).
    i. Other system operating conditions that affect performance.
16. Test conditions for pump performance forms, including the following:
    a. Variable-frequency controller settings for variable-flow hydronic systems.
    b. Settings for pressure controller(s).
    c. 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, 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 speed.
   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 speed.
   d. Inlet and discharge static pressure in inches wg.
   e. For each filter bank, 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. List for each internal component with pressure-drop, static-pressure differential in inches wg.
   j. Outdoor airflow in cfm.
   k. Return airflow in cfm.
   l. Outdoor-air damper position.
   m. Return-air damper position.

F. Apparatus-Coil Test Reports:
1. Coil Data:
   a. System identification.
   b. Location.
   c. Coil type.
   d. Number of rows.
   e. Fin spacing in fins per inch o.c.
   f. Make and model number.
   g. Face area in sq. ft..
   h. Tube size in NPS.
   i. Tube and fin materials.
   j. Circuiting arrangement.
2. Test Data (Indicated and Actual Values):
   a. 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. Refrigerant expansion valve and refrigerant types.
   i. Refrigerant suction pressure in psig.

j. Refrigerant suction temperature in deg F.

G. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
1. Unit Data:
a. System identification.
b. Location.
c. Coil identification.
d. Capacity in Btu/h.
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.
h. Airflow rate in cfm.
i. Face area in sq. ft..
j. Minimum face velocity in fpm.
2. Test Data (Indicated and Actual Values):
a. Heat output in Btu/h.
b. Airflow rate in cfm.
c. Air velocity in fpm.
d. Entering-air temperature in deg F.
e. Leaving-air temperature in deg F.
f. Voltage at each connection.
g. Amperage for each phase.

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 speed.
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 speed.
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 fan and air-handling-unit number.
      b. Location and zone.
      c. Traverse air temperature in deg F.
      d. Duct static pressure in inches wg.
      e. Duct size in inches.
      f. Duct area in sq. ft..
      g. Indicated 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. Air-Terminal-Device Reports:
   1. Unit Data:
      a. System and air-handling unit identification.
      b. Location and zone.
      c. Apparatus used for test.
      d. Area served.
      e. Make.
      f. Number from system diagram.
      g. Type and model number.
      h. Size.
      i. Effective area in sq. ft..
   2. Test Data (Indicated and Actual Values):
      a. Airflow rate in cfm.
      b. Air velocity in fpm.
      c. Preliminary airflow rate as needed in cfm.
      d. Preliminary velocity as needed in fpm.
      e. Final airflow rate in cfm.
      f. Final velocity in fpm.
      g. Space temperature in deg F.

K. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
   1. Unit Data:
      a. System and air-handling-unit identification.
      b. Location and zone.
      c. Room or riser served.
      d. Coil make and size.
      e. Flowmeter type.
   2. Test Data (Indicated and Actual Values):
      a. 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.

L. Indoor-Air Quality Measurement Reports for Each HVAC System:
   1. HVAC system designation.
   2. Date and time of test.
   3. Outdoor temperature, relative humidity, wind speed, and wind direction at start of test.
   4. Room number or similar description for each location.
   5. Measurements at each location.
   6. Observed deficiencies.

M. Instrument Calibration Reports:
   1. Report Data:
      a. Instrument type and make.
      b. Serial number.
      c. Application.
      d. Dates of use.
      e. Dates of calibration.

3.17 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of the Architect, Owner's representative or Commissioning authority.

B. Architect, Owner's representative or 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 recheck measurements find the number of failed measurements noncompliant with requirements indicated, 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. All changes shall be tracked to show changes made to previous report.
   2. If the second final inspection also fails, Owner may pursue others Contract options to complete TAB work.

F. Prepare test and inspection reports.

3.18 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulation for the following HVAC services:
   1. HVAC piping.
   2. HVAC equipment.
   3. HVAC duct services.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail attachment and covering of heat tracing inside insulation.
   3. Detail insulation application at pipe expansion joints for each type of insulation.
   4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   5. Detail removable insulation at piping specialties.
   6. Detail removable insulation at equipment connections.
   7. Detail application of field-applied jackets.
   8. Detail application at linkages of control devices.
   9. Detail field application for each equipment type.

C. Samples:
   1. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

1.5 QUALITY ASSURANCE

A. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.

1. Piping Mockups:
   a. One 10-foot section of NPS 2 straight pipe.
   b. One each of a 90-degree threaded, welded, and flanged elbow.
   c. One each of a threaded, welded, and flanged tee fitting.
   d. One NPS 2 or smaller valve, and one NPS 2-1/2 or larger valve.
   e. Four support hangers including hanger shield and insert.
   f. One threaded strainer and one flanged strainer with removable portion of insulation.
   g. One threaded reducer and one welded reducer.
   h. One pressure temperature tap.
   i. One mechanical coupling.
2. Equipment Mockups:
   a. One chilled-water pump and one heating-hot-water pump.
   b. One tank or vessel.
3. Ductwork Mockups:
   a. One 10-foot section each of rectangular and round straight duct.
   b. One each of a 90-degree mitered round and rectangular elbow, and one each of a 90-degree radius round and rectangular elbow.
   c. One rectangular branch takeoff and one round branch takeoff from a rectangular duct. One round tee fitting.
   d. One rectangular and round transition fitting.
   e. Four support hangers for round and rectangular ductwork.
   f. Each type of damper and specialty.
4. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
5. Notify Architect seven days in advance of dates and times when mockups will be constructed.
6. Obtain Architect's approval of mockups before starting insulation application.
7. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
8. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
9. Demolish and remove mockups when directed.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields.

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to 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 agency.
   1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

A. Comply with requirements in PART 3 - EXECUTION articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric Insulation:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Aeroflex USA, Inc.
b. Airex Manufacturing
c. Armacell LLC
d. K-Flex USA
2. Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
3. Thermal conductivity (k-value) at 75 deg F shall be 0.25 Btu x in./h x sq. ft. x deg F or less (1-inch wall).

G. Mineral-Fiber Blanket Insulation:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. CertainTeed Corporation
b. Johns Manville; a Berkshire Hathaway company
c. Knauf Insulation
d. Manson Insulation Inc.
e. Owens Corning
2. Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I without factory-applied jacket, Type II with factory-applied vinyl jacket or Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
3. Compressed thermal conductivity (k-value) at 75 deg F shall be 0.25 Btu x in./h x sq. ft. x deg F or less. Minimum installed R-Value of 3.0 ($hr \cdot ft^2 \cdot °F$)/Btu per inch thickness.

H. Mineral-Fiber, Preformed Pipe Insulation:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. CertainTeed Corporation
b. Johns Manville; a Berkshire Hathaway company
c. Knauf Insulation
d. Manson Insulation Inc.
e. Owens Corning
2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ or ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
3. Thermal conductivity (k-value) at 75 deg F shall be 0.23 Btu x in./h x sq. ft. x deg F or less.

I. Mineral-Fiber Board Insulation:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. CertainTeed Corporation
b. Johns Manville; a Berkshire Hathaway company
c. Knauf Insulation
d. Manson Insulation Inc.
e. Thermafiber, Inc.; an Owens Corning company

2. Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation with factory-applied ASJ or ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
3. Thermal conductivity (k-value) at 75 deg F shall be 0.23 Btu x in./h x sq. ft. x deg F or less.

J. Polyisocyanurate:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Dow
   b. ITW Insulation Systems; Illinois Tool Works, Inc.
   c. Johns Manville; a Berkshire Hathaway company
2. Faced, rigid cellular polyisocyanurate sheathing material intended for use as thermal duct insulation.
3. Comply with ASTM C1289 Type 1, Class 1. The compressive resistance shall not be less than 16.0 psi and a minimum installed R-Value of 6.0 (hr•ft2•°F)/Btu per inch thickness.
4. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
   a. Duct Applications: FSK.

2.3 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F. Comply with ASTM C 656, Type II, Grade 6. Tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Johns Manville; a Berkshire Hathaway company

B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. 3M
   b. CertainTeed Corporation
   c. Johns Manville; a Berkshire Hathaway company
   d. Nelson Firestop; a brand of Emerson Industrial Automation
   e. Thermal Ceramics
   f. Unifrax Corporation

2.4 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

2.5 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. For indoor applications, use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Aeroflex USA, Inc.
2. Armacell LLC
3. Childers Brand; H. B. Fuller Construction Products
4. Dow Corning Corporatio
5. Eagle Bridges - Marathon Industries
6. Foster Brand; H. B. Fuller Construction Products.
7. Johns Manville; a Berkshire Hathaway company
8. K-Flex USA
9. P.I.C. Plastics, Inc.
10. Mon-Eco Industries, Inc.
11. Speedline Corporation
12. Vimasco Corporation.

D. Polyisocyanurate Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.

E. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

F. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

G. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

2.6 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

B. For indoor applications, use mastics that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Childers Brand; H. B. Fuller Construction Products
2. Eagle Bridges - Marathon Industries
3. Foster Brand; H. B. Fuller Construction Products.
4. Knauf Insulation
5. Mon-Eco Industries, Inc.
6. Vimasco Corporation

D. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
   1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
   2. Service Temperature Range: Minus 20 to plus 180 deg F.
   3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
   4. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
   1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
   2. Service Temperature Range: Minus 20 to plus 180 deg F.
   3. Solids Content: 60 percent by volume and 66 percent by weight.
   4. Color: White.

2.7 LAGGING ADHESIVES

A. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Childers Brand; H. B. Fuller Construction Products
   2. Foster Brand; H. B. Fuller Construction Products.
   3. Vimasco Corporation

C. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
   1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
   2. Service Temperature Range: 0 to plus 180 deg F.
   3. Color: White.

2.8 SEALANTS

A. Use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Childers Brand; H. B. Fuller Construction Products
   2. Eagle Bridges - Marathon Industries
   3. Foster Brand; H. B. Fuller Construction Products.
   4. Knauf Insulation
   5. Mon-Eco Industries, Inc.
   6. Pittsburgh Corning Corporation
   7. Vimasco Corporation

C. Cellular-Glass and Polyisocyanurate Joint Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.

2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.

D. FSK and Metal Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.

E. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.9 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.10 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Alpha Associates, Inc

2.11 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. Metal Jacket:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ITW Insulation Systems; Illinois Tool Works, Inc.
b. RPR Products, Inc.

2. Aluminum Jacket: Comply with ASTM B 209, ASTM C 1729, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
    a. Factory cut and rolled to size.
    b. Finish and thickness are indicated in field-applied jacket schedules.
    c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
    d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
    e. Factory-Fabricated Fitting Covers:
        1) Same material, finish, and thickness as jacket.
        2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
        3) Tee covers.
        4) Flange and union covers.
        5) End caps.
        6) Beveled collars.
        7) Valve covers.
        8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
    a. Factory cut and rolled to size.
    b. Material, finish, and thickness are indicated in field-applied jacket schedules.
    c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
    d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
    e. Factory-Fabricated Fitting Covers:
        1) Same material, finish, and thickness as jacket.
        2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
        3) Tee covers.
        4) Flange and union covers.
        5) End caps.
        6) Beveled collars.
        7) Valve covers.
        8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

D. Self-Adhesive Outdoor Jacket: 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with white aluminum-foil facing.
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        a. Polyguard Products, Inc.
    2. Warranty: Minimum 10-year warranty that water will not leak directly through membrane as a result of deterioration of the membrane caused by ordinary wear and tear.

2.12 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Width: 3 inches.
   2. Thickness: 11.5 mils.
   3. Adhesion: 90 ounces force/inch in width.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch in width.
   6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
   1. Width: 3 inches.
   2. Thickness: 6.5 mils.
   3. Adhesion: 90 ounces force/inch in width.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch in width.
   6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
   1. Width: 2 inches.
   2. Thickness: 3.7 mils.
   3. Adhesion: 58 ounces force/inch in width.
   4. Elongation: 8.5 percent.
   5. Tensile Strength: 23 lbf/inch in width.

2.13 SECUREMENTS

A. Bands:
   1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal.
   2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.

B. Insulation Pins and Hangers:
   1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch diameter shank, length to suit depth of insulation indicated.
   2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
   3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
      a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
      b. Spindle: Aluminum, 0.106-inch- diameter shank, length to suit depth of insulation indicated.

c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
   a. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
   b. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
   c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
   a. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   b. Spindle: Aluminum, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
   c. Adhesive-backed base with a peel-off protective cover.
6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

2.14 CORNER ANGLES

A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

B. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
   1. For exterior, above-grade piping: Before insulating, apply a corrosion coating to insulated surfaces as follows:
      a. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
      b. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, duct and piping, including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials clean and dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
      a. For below-ambient services, apply vapor-barrier mastic over staples.
   4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:
   1. Vibration-control devices.
   2. Testing agency labels and stamps.
   3. Nameplates and data plates.
   4. Manholes.
   5. Handholes.
   6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
   4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
   1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:
   1. Pipe: Install insulation continuously through floor penetrations.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
   1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Insulate reheat coils, including exposed tubing U-bends, on concealed air terminal units.

E. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

3.6 INSTALLATION OF CALCIUM SILICATE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
4. Finish flange insulation same as pipe insulation.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
3. Finish fittings insulation same as pipe insulation.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
2. Install insulation to flanges as specified for flange insulation application.
3. Finish valve and specialty insulation same as pipe insulation.

E. Insulation Installation on Boiler Breechings:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation material.
2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. On exposed applications without metal jacket, finish insulation surface with a skim coat of mineral-fiber, hydraulic-setting cement. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth. Thin finish coat to achieve smooth, uniform finish.

3.7 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.8 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
   1. Install pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
   4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install mitered sections of pipe insulation.
   2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed valve covers manufactured of same material as pipe insulation when available.
   2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.
   4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

E. Insulation Installation for Tanks and Vessels:
   1. Install insulation over entire surface of tanks and vessels.
   2. Apply 50 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
   3. Seal longitudinal seams and end joints.

F. Insulation Installation on Pumps:
   1. Fabricate metal boxes lined with elastomeric insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch- diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
   2. Fabricate boxes from aluminum, at least 0.040 inch thick.
   3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

G. Insulation Installation on HVAC Ducts
   1. Install insulation over entire surface of ducts.

2. Apply 50 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
3. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

H. Provide latex-based, UV resistant protective coating for outdoor applications.

3.9 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

E. Insulation Installation for Tanks and Vessels:
1. Secure insulation with adhesive and anchor pins and speed washers.
2. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of tank and vessel surfaces.

3. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
4. Protect exposed corners with secured corner angles.
5. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
    a. Do not weld anchor pins to ASME-labeled pressure vessels.
    b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
    d. Do not overcompress insulation during installation.
    e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    f. Impale insulation over anchor pins and attach speed washers.
    g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
6. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
7. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
8. Stagger joints between insulation layers at least 3 inches.
9. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
10. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
11. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

F. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.

b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. Impale insulation over pins and attach speed washers.
f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

G. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not overcompress insulation during installation.
   e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.10 INSTALLATION OF POLYISOCYANURATE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. Orient longitudinal joints between half sections in 3- and 9-o'clock positions on the pipe.
2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch thickness.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyisocyanurate block insulation of same thickness as pipe insulation.

C. Insulation Installation on Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of polyisocyanurate insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.

E. Insulation Installation on Ducts and Plenums:
1. Install insulation over entire surface of ducts.
2. Apply minimum 50 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
3. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.11 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.12 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

3.13 FIELD QUALITY CONTROL

A. If workmanship is of questionable quality, the contractor shall perform tests and inspections as directed by the Architect.

B. Tests and Inspections:

1. Inspect field insulated equipment, ductwork, pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.14 INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. HVAC Piping Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

C. HVAC Equipment Items Not Insulated: Unless otherwise indicated, do not install insulation on equipment that is factory insulated.

D. HVAC Ducts Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.15 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:
1. All Pipe Sizes: Insulation shall be one of the following:
a. Flexible Elastomeric: 3/4 inch thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 1 inch thick.

C. Refrigerant Suction and Hot-Gas Flexible Tubing:
1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 1 inch thick.

D. For piping smaller than 1 1/2 inches and located in partitions within conditioned spaces, reduction of the scheduled thickness by 1 inch shall be permitted, but not to a thickness less than 1 inch.

3.16 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:
1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 2 inches thick.

B. Refrigerant Suction and Hot-Gas Flexible Tubing:
1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 2 inches thick.

3.17 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, supply-air and outdoor-air duct insulation shall be the following:
1. Above Ceiling: Mineral-Fiber Blanket: 2 inches thick and 1-lb/cu. ft. nominal density.
2. Within Shafts: Mineral-Fiber Board: 2 inches thick and 6-lb/cu. ft. nominal density.

B. Concealed, return-air duct insulation shall be the following (shafts only):
1. Mineral-Fiber Board: 1 inch thick and 6-lb/cu. ft. nominal density.

C. Concealed, exhaust-air heat recovery duct insulation shall be the following:
1. Above Ceiling: Mineral-Fiber Blanket: 1 inch thick and 1-lb/cu. ft. nominal density.
2. Within Shafts: Mineral-Fiber Board: 1 inch thick and 6-lb/cu. ft. nominal density.

D. Concealed, exhaust-air duct insulation between isolation damper and penetration of building exterior shall be the following:
1. Mineral-Fiber Blanket: 2 inches thick and 1-lb/cu. ft. nominal density.

E. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation:
1. Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.

F. Concealed, supply-air devices shall be the following:
1. Mineral-Fiber Blanket: 1 inch thick and 1-lb/cu. ft. nominal density.

G. Exposed, supply-air and outdoor duct insulation shall be the following (unfinished areas):
1. Mineral-Fiber Board: 2 inches thick and 6-lb/cu. ft. nominal density.

H. Exposed, return-air duct insulation shall be the following (unfinished areas):

1. Mineral-Fiber Board: 1 inch thick and 6-lb/cu. ft. nominal density.

I. Exposed, exhaust-air heat recovery duct insulation shall be the following:
1. Mineral-Fiber Board: 1 inch thick and 6-lb/cu. ft. nominal density.

J. Exposed, exhaust-air duct insulation between isolation damper and penetration of building exterior shall be the following:
1. Mineral-Fiber Board: 1 inch thick and 6-lb/cu. ft. nominal density.

K. Exposed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated board; thickness as required to achieve 2-hour fire rating.

L. Exposed, supply-air, outdoor-air and exhaust-air plenum insulation shall be the following:
1. Mineral-Fiber Board: 2 inches thick and 6-lb/cu. ft. nominal density.

M. Exposed, return-air plenum insulation shall be the following:
1. Mineral-Fiber Board: 1 inch thick and 6-lb/cu. ft. nominal density.

3.18 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.

B. Exposed, supply-air and outdoor-air duct insulation shall be the following:
1. Polyisocyanurate Sheathing: 2 inches.

C. Exposed, return-air duct insulation shall be the following:
1. Polyisocyanurate Sheathing: 2 inches.

3.19 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Piping, Concealed:

1. None.

C. Piping, Exposed:
1. **Woven Glass-Fiber Fabric**.

D. Equipment, Concealed:
1. None.

E. Equipment, Exposed:
1. None.

F. Ducts and Plenums, Concealed:
1. None.

G. Ducts and Plenums, Exposed:
1. **Woven Glass-Fiber Fabric.**

3.20 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Piping, Concealed:

1. None.

C. Piping, Exposed:
1. Aluminum, Stucco Embossed with Z-Shaped Locking Seam. Minimum jacket thickness shall be based on the outer insulation diameter:
a. 8-inches and smaller: 0.024 inches thick.
b. 10-inches to 36-inches: 0.032 inches thick.
c. 38-inches and larger: 0.040 inches thick.
2. Stainless Steel, Type 304 or Type 316, Stucco Embossed with Z-Shaped Locking Seam: 0.024 inch thick.
3. Self-Adhesive Outdoor Jacket: 60-mil- thick.

D. Equipment, Concealed:

1. None.

E. Ducts and Plenums, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
1. Aluminum, Stucco Embossed: 0.040 inch thick.
2. Stainless Steel, Type 304 or Type 316, Stucco Embossed: 0.024 inch thick.
3. Self-Adhesive Outdoor Jacket: 60-mil- thick.

F. Ducts and Plenums, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
1. Aluminum, Stucco Embossed with 1-1/4-Inch- Deep Corrugations: 0.040 inch thick.
2. Stainless Steel, Type 304 or Type 316, Stucco Embossed, with 1-1/4-Inch- Deep Corrugations: 0.024 inch thick.
3. Self-Adhesive Outdoor Jacket: 60-mil- thick.

END OF SECTION 230700

SECTION 230900 - BUILDING AUTOMATION AND TEMPERATURE CONTROL 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. Section includes fully integrated building automation system, incorporating direct digital control (DDC) for energy management, equipment monitoring and control, and subsystems with open communications capabilities as herein specified:

1.3 SCOPE

A. The work for the Building Automation and Temperature Control System will be performed by the Siemens Building Technologies <u>under direct contract with Coastal Carolina University</u>. This specification is for information and coordination purposes only.

1. The Building Automation System (BAS) cost and scope of work shall NOT be included under the scope and responsibility of the Contractor.
2. The contractors under the construction contract shall coordinate and cooperate with the BAS contractor to ensure that the BAS contractor can accomplish the work required in this section in an appropriate and timely manner.
3. The contractor shall be responsible for performing corrective actions required by the BAS contractor.
4. The local contact for Siemens Building Technologies for the project is Control Management, Inc (803-765-9070).

B. The Building Automation System (BAS) manufacturer shall furnish and install a fully integrated building automation system, incorporating direct digital control (DDC) for energy management, equipment monitoring and control, and subsystems with open communications capabilities as herein specified.

C. The BAS shall be a Web based system communicating over the building owners Local Area Network (LAN). Contractor shall be responsible for coordination with the owner's IT staff to ensure that the BAS will perform in the owner's environment without disruption to any of the other activities taking place on that LAN. TCP/IP connections and addresses shall be provided by the owner for connection of supervisory panels to the Coastal Carolina University network.

D. The primary desktop and laptop interface will be via a standard Web Browser such as Internet Explorer or Netscape. BAS contractor shall provide software license(s) for BAS WEB access for a minimum of twenty concurrent users.

E. The installation of the control system shall be performed under the direct supervision of the controls manufacturer with the shop drawings, flow diagrams, bill of materials, component designation or identification number and sequence of operation all bearing the name of the manufacturer. The installing manufacturer shall certify in writing, that the shop drawings have been prepared by the equipment manufacturer and that the equipment manufacturer has supervised their installation. In addition, the equipment manufacturer shall certify, in writing, that the shop drawings were prepared by their company and that all temperature control equipment was installed under their direct supervision.

F. All materials and equipment used shall be standard components, regularly manufactured for this and/or other systems and not custom designed especially for this project. All systems and components shall have been thoroughly tested and proven in actual use for at least two years.

G. BAS manufacturer shall be responsible for all BAS and Temperature Control wiring for a complete and operable system. All wiring shall be done in accordance with all local and national codes.

H. Control contractor shall furnish and field install all air handling unit end devices. Control contractor shall provide data sheets on all components to be mounted, indicating component dimensions, mounting hardware, and methods, as well as wiring and piping diagrams for each application identified by unit tag per the schedule in the drawings.

I. Variable Frequency Drives (VFDs):

1. All pump VFDs, and VFDs for fans not in air handling units, shall be furnished and installed (set in place) by the BAS provider.
2. Air handling unit VFDs shall be furnished and installed by the air handling unit manufacturer.
3. Power wiring for VFDs shall be provided under Division 26.
4. Refer to Section 230550 "Variable Frequency Drives".

J. Air handling unit end devices shall be furnished by the BAS manufacturer and field installed by the control contractor.

K. Lighting Panel BAS Scope of Work

1. BAS Controls Contractor shall provide all necessary materials and labor to integrate with the lighting panels as shown on the electrical drawings.

L. BAS provider shall provide IT cabling and network between devices, controllers and building controllers so that a complete BAS is installed, functional and accessible via tie into the BAS network from a single location during TAB and commissioning. BAS network and cabling shall be compliant with and compatible with the Owner's IT department requirements so that BAS may be connected to a Owner's switch(s) once that system is complete. In no case shall Owner's IT system completion be justification for delay in completing, testing and commissioning BAS system.

1.4 INTERFACE REQUIRMENTS

A. The new system shall be an extension of and connected to the existing Siemens management system which is used for energy management.

B. The BAS contractor shall provide all necessary hardware and software to integrate the new control system with the existing Siemens BAS without additional hardware or gateways. Integration means the ability to monitor, override, change set points, and provide real-time bi-directional dynamic data exchange between the new control system and the existing BAS hardware and software.

C. The existing BAS is a Siemens system. The BAS is comprised of multiple supervisory controllers, monitoring and communicating with various building control systems over the Ethernet LAN system. The new building control system will be connected to, and communicate with, the existing campus BAS server via the Ethernet LAN

D. All new control points, monitoring points and software points shall be added to the existing Siemens BAS database and shall be available for monitoring and adjustment at any computer, with current copy of Microsoft Internet Explorer software (Release 6.0 or later), that is connected to the Coastal Carolina University LAN.

E. All new building software and databases shall be archived on the hard drive at the BAS server. In the event that any building controller should lose its program that controller's archived software program shall be downloaded across the BAS network from the BAS server to the respective building controller.

F. The BAS contractor will provide all necessary hardware, software, and labor to allow communication with all any computer, with current copy of Microsoft Internet Explorer (Release 6.0 or later), that is connected to the LAN.

G. Integrity of the existing BAS shall be maintained during installation.

H. The new building control system shall be compatible in every respect with existing Siemens BAS hardware and software. All new controllers shall be compatible with Siemens database and software development tools.

1.5 WORK BY OTHERS

A. Electrical Contractor provides:

1. 120V power to all BAS and/or Temperature control panels. Where not shown on plans, locations shall be determined by the BAS contractor and coordinated with the Architect and electrical contractor.
2. Wiring of all power feeds through all disconnect starters to electrical motor.
3. Wiring of any remote start/stop switches and manual or automatic motor speed control devices not furnished by BAS manufacturer.
4. Wiring of electrical sub-metering devices furnished by BAS manufacturer.

B. Control Devices for Installation by Installers

1. Deliver selected control devices, specified in indicated HVAC instrumentation and control device Sections, to identified equipment and systems manufacturers for factory installation and to identified installers for field installation.
2. Deliver the following to duct fabricator and installer for installation in ductwork. Include installation instructions to Installer and supervise installation for compliance with requirements.

    a. Airflow measuring stations (duct and fan array)
    b. Airflow sensors and switches
    c. Pressure sensors.

3. Deliver the following to plumbing and HVAC piping installers for installation in piping. Include installation instructions to Installer and supervise installation for compliance with requirements.

    a. DDC control valves

4. Deliver the following to electrical installers for installation. Include installation instructions to Installer and supervise installation for compliance with requirements.

    a. Electrical Meters/Sub-Metering Devices

C. Communication Interface to Equipment with Integral Controls

1. DDC system shall have communication interface with equipment having integral controls and having a communication interface for remote monitoring or control.
2. Equipment to Be Connected:

    a. Air-terminal units
    b. Domestic water booster pumps.
    c. Fan coil units
    d. Split-system air-conditioners
    e. Sump pump unit controllers
    f. Variable-frequency controllers

D. Communication Interface to Other Building Systems:

1. DDC system shall have a communication interface with systems having a communication interface.
2. Systems to Be Connected:

    a. Access controls.
    b. Elevators.
    c. Fire-alarm system
    d. Lighting controls. BAS shall connect to all Lighting Control panels and contactors for lighting control. Refer to the electrical drawings for location and quantity.
    e. Power monitoring.

E. The control manufacturer shall cooperate with the air and water balancing agency in the performance of their work as required or directed.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product include the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation, operation and maintenance instructions including factors effecting performance.
5. Bill of materials of indicating quantity, manufacturer, and extended model number for each unique product.

    a. Workstations.
    b. Servers.
    c. Gateways.
    d. Routers.
    e. DDC controllers.
    f. Enclosures.
    g. Electrical power devices.
    h. UPS units.
    i. Accessories.
    j. Instruments.
    k. Control damper actuators.
    l. Control valves and actuators.

6. When manufacturer's product datasheets apply to a product series rather than a specific product model, clearly indicate and highlight only applicable information.
7. Each submitted piece of product literature shall clearly cross reference specification and drawings that submittal is to cover.

B. Shop Drawings:

1. General Requirements:

    a. Include cover drawing with Project name, location, Owner, Architect, Contractor and issue date with each Shop Drawings submission.
    b. Include a drawing index sheet listing each drawing number and title that matches information in each title block.
    c. Drawings Size: 11x17.

2. Include plans, elevations, sections, and mounting details where applicable.
3. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

4. Detail means of vibration isolation and show attachments to rotating equipment.
5. Plan Drawings indicating the following:

    a. Screened backgrounds of walls, structural grid lines, HVAC equipment, ductwork and piping.
    b. Room names and numbers with coordinated placement to avoid interference with control products indicated.
    c. Each desktop workstation, server, gateway, router, DDC controller, control panel instrument connecting to DDC controller, and damper and valve connecting to DDC controller, if included in Project.
    d. Exact placement of products in rooms, ducts, and piping to reflect proposed installed condition.
    e. Network communication cable and raceway routing.
    f. Information, drawn to scale, of ¼"=1'-0".
    g. Proposed routing of wiring, cabling, conduit, and tubing, coordinated with building services for review before installation.

6. Schematic drawings for each controlled HVAC system indicating the following:

    a. I/O points labeled with point names shown. Indicate instrument range, normal operating set points, and alarm set points. Indicate fail position of each damper and valve, if included in Project.
    b. I/O listed in table format showing point name, type of device, manufacturer, model number, and cross-reference to product data sheet number.
    c. A graphic showing location of control I/O in proper relationship to HVAC system.
    d. Wiring diagram with each I/O point having a unique identification and indicating labels for all wiring terminals.
    e. Unique identification of each I/O that shall be consistently used between different drawings showing same point.
    f. Elementary wiring diagrams of controls for HVAC equipment motor circuits including interlocks, switches, relays and interface to DDC controllers.
    g. Narrative sequence of operation.
    h. Graphic sequence of operation, showing all inputs and output logical blocks.

7. Control panel drawings indicating the following:

    a. Panel dimensions, materials, size, and location of field cable, raceways, and tubing connections.
    b. Interior subpanel layout, drawn to scale and showing all internal components, cabling and wiring raceways, nameplates and allocated spare space.
    c. Front, rear, and side elevations and nameplate legend.
    d. Unique drawing for each panel.

8. DDC system network riser diagram indicating the following:

    a. Each device connected to network with unique identification for each.
    b. Interconnection of each different network in DDC system.
    c. For each network, indicate communication protocol, speed and physical means of interconnecting network devices, such as copper cable type, or optical fiber cable type. Indicate raceway type and size for each.

d. Each network port for connection of an operator workstation or other type of operator interface with unique identification for each.

9. DDC system electrical power riser diagram indicating the following:

a. Each point of connection to field power with requirements (volts/phase//hertz/amperes/connection type) listed for each.
b. Each control power supply including, as applicable, transformers, power-line conditioners, transient voltage suppression and high filter noise units, DC power supplies, and UPS units with unique identification for each.
c. Each product requiring power with requirements (volts/phase//hertz/amperes/connection type) listed for each.
d. Power wiring type and size, race type, and size for each.

10. Monitoring and control signal diagrams indicating the following:

a. Control signal cable and wiring between controllers and I/O.
b. Point-to-point schematic wiring diagrams for each product.
c. Control signal tubing to sensors, switches and transmitters.
d. Process signal tubing to sensors, switches and transmitters.

11. Color graphics indicating the following:

a. Itemized list of color graphic displays to be provided.
b. For each display screen to be provided, a true color copy showing layout of pictures, graphics and data displayed.
c. Intended operator access between related hierarchical display screens.

C. System Description:

1. Full description of DDC system architecture, network configuration, operator interfaces and peripherals, servers, controller types and applications, gateways, routers and other network devices, and power supplies.
2. Complete listing and description of each report, log and trend for format and timing and events which initiate generation.
3. System and product operation under each potential failure condition including, but not limited to, the following:

a. Loss of power.
b. Loss of network communication signal.
c. Loss of controller signals to inputs and outpoints.
d. Operator workstation failure.
e. Server failure.
f. Gateway failure.
g. Network failure
h. Controller failure.
i. Instrument failure.
j. Control damper and valve actuator failure.

4. Complete bibliography of documentation and media to be delivered to Owner.

5. Description of testing plans and procedures.
6. Description of Owner training.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For DDC system 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. Project Record Drawings of as-built versions of submittal Shop Drawings provided in electronic PDF format.
   b. Testing and commissioning reports and checklists of completed final versions of reports, checklists, and trend logs.
   c. As-built versions of submittal Product Data.
   d. Names, addresses, e-mail addresses and 24-hour telephone numbers of Installer and service representatives for DDC system and products.
   e. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control and changing set points and variables.
   f. Programming manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
   g. Engineering, installation, and maintenance manuals that explain how to:

      1) Design and install new points, panels, and other hardware.
      2) Perform preventive maintenance and calibration.
      3) Debug hardware problems.
      4) Repair or replace hardware.

   h. Documentation of all programs created using custom programming language including set points, tuning parameters, and object database.
   i. Backup copy of graphic files, programs, and database on electronic media such as DVDs.
   j. List of recommended spare parts with part numbers and suppliers.
   k. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
   l. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software.
   m. Licenses, guarantees, and warranty documents.
   n. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
   o. Owner training materials.

1.8 QUALITY ASSURANCE

A. The BAS system shall be designed and installed, commissioned and serviced by manufacturer employed, factory trained personnel. Manufacturer shall have an in-place support facility within 20 miles of the site with technical staff, spare parts inventory and necessary test and diagnostic equipment.

B. The manufacturer shall provide full time, on site, experienced project manager for this work, responsible for direct supervision of the design, installation, start up and commissioning of the BAS.

C. The Bidder shall be regularly engaged in the manufacturing, installation and maintenance of BAS systems and shall have a minimum of ten (10) years of demonstrated technical expertise and experience in the manufacture, installation and maintenance of BAS systems similar in size and complexity to this project.

D. Materials and equipment shall be the catalogued products of manufacturers regularly engaged in production and installation of automatic temperature control systems and shall be manufacturer's latest standard design that complies with the specification requirements.

E. This system shall have a documented history of compatibility by design for a minimum of 15 years. Future compatibility shall be supported for no less than 10 years. Compatibility shall be defined as the ability to upgrade existing field panels to current level of technology and extend new field panels on a previously installed network.

1.9 PERFORMANCE REQUIREMENTS

A. Comply with the following performance requirements:

1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
6. Program Execution Frequency: Run capability of applications as often as five seconds but selected consistent with mechanical process under control.
7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:

    a. Water Temperature: Plus or minus 1 deg F.
    b. Water Flow: Plus or minus 2 percent of full scale.
    c. Water Pressure: Plus or minus 2 percent of full scale.

d. Space Temperature: Plus or minus 1 deg F.
e. Ducted Air Temperature: Plus or minus 1 deg F.
f. Outside Air Temperature: Plus or minus 2 deg F.
g. Dew Point Temperature: Plus or minus 3 deg F.
h. Temperature Differential: Plus or minus 0.25 deg F.
i. Relative Humidity: Plus or minus 5 percent.
j. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
k. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
l. Airflow (Terminal): Plus or minus 10 percent of full scale.
m. Air Pressure (Space): Plus or minus 0.01-inch wg.
n. Air Pressure (Ducts): Plus or minus 0.1-inch wg.
o. Carbon Dioxide: Plus or minus 50 ppm.
p. Electrical: Plus or minus 5 percent of reading.

B. Surface-Burning Characteristics: Products installed in ducts, equipment, and return-air paths shall comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace products that fail in materials or workmanship within specified warranty period.

1. Failures shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner.
2. Include updates or upgrades to software and firmware if necessary to resolve deficiencies.

a. Install updates only after receiving Owner's written authorization.

3. Warranty service shall occur during normal business hours and commence within 24 hours of Owner's warranty service request.
4. Warranty Period: Five year(s) from date of Substantial Completion.

a. For Gateway: Five-year parts and labor warranty for each.

B. The on-line support services shall allow the local BAS subcontractor to dial out over telephone lines to monitor and control the facility's building automation system. This remote connection to the facility shall be within 2 hours of the time that the problem is reported. This coverage shall be extended to include normal business hours, after business hours, weekends and holidays.

1.11 IDENTIFICATION

A. Identify control wires with a distinctive number on a nonconducting tag attached to each end or at junction points or by color coding of that wire or tube. Designate on control diagram the identifying color and/or number or other identifying designation used.

B. Identify all control equipment and devices, including panels, controllers, valves, and automatic dampers, firestats, etc., by a method approved by the Architect. Designations shall match those used on control diagrams and shop drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Basis-of-Design Product: Subject to compliance with requirements, provide a building automation and temperature control system by Siemens Building Technologies, Inc./Control Management, Inc (CMI).

B. System must extend and connect to the existing Siemens network control systems installed in Coastal Carolina University.

2.2 GENERAL DESCRIPTION

A. The Building Automation System (BAS) shall use an open architecture. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other owner provided networks.

B. The Building Automation shall consist of the following:
1. Standalone Network Control Engine (NCE)
2. Field Equipment Controller(s)
3. Input/Output Module(s)
4. Local Display Device(s)
5. Distributed User Interface(s)
6. Network processing, data storage and communications equipment
7. Other components required for a complete and working BAS

C. The system shall be modular in nature and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.

D. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

2.3 BAS ARCHITECTURE

A. Automation Network
1. The BAS shall network multiple user interface clients, automation engines, system controllers and application-specific controllers. Utilize existing application and data server as required for systems operation.
2. The automation network shall be capable of operating at a communication speed of 100 Mbps, with full peer-to-peer network communication.
3. Network Control Engine (NCE) shall reside on the automation network.
4. The automation network will be compatible with other campus-wide networks. Where indicated, the automation network shall be connected to the campus network and share resources with it by way of standard networking devices and practices.

B. Control Network
1. Network Control Engine (NCE) shall provide supervisory control over the control network.
2. Control networks shall provide either "Peer-to-Peer," Master-Slave, or Supervised Token Passing communications, and shall operate at a minimum communication speed of 38,400 baud.
3. DDC Controllers shall reside on the control network
4. Wireless communication between DDC controllers is acceptable. All sensors shall be wired.

C. Dedicated Web Based User Interface
1. The BAS Contractor shall provide and install a personal computer for command entry, information management, network alarm management, and database management functions. Real-time control functions, including scheduling, history collection and alarming, shall be resident in the BAS Network Engines and Data Server to facilitate greater fault tolerance and reliability.
2. Dedicated User Interface Architecture – The architecture of the computer shall be implemented to conform to industry standards, so that it can accommodate applications provided by the BAS Contractor and by other third-party applications suppliers, including but not limited to Microsoft Office Applications. Specifically, it must be implemented to conform to the following interface standards.
    a. Edge or Google Chrome or Safari for user interface functions.
    b. Microsoft Office Professional for creation, modification and maintenance of reports, sequences other necessary building management functions.
    c. Microsoft Outlook or other e-mail program for supplemental alarm functionality and communication of system events, and reports.
    d. Required network operating system for exchange of data and network functions such as printing of reports, trends and specific system summaries.
3. PC Hardware/Software – The personal computer(s) shall be configured as specified in the Computing Hardware and Software section.
4. Provide one operational device as herein specified and located on plans.
5. Mobile, Web Based, User Interface (MUI) General
    a. All functionality as outlined within this section shall be provided as a standard catalog product software suite from the BAS manufacturer. Custom functionality development to meet these requirements is not acceptable.
    b. The mobile, web-based, user interface shall be HTML5-compliant and provide access to the system from smartphones, tablets, portable and desktop computers.

User Interfaces that require software installation on the client device (e.g. Java, MicrosoftSilverlight®, Adobe® Flash®), or software downloads from an online app store shall not be acceptable for these purposes.

c. The mobile user interface shall provide system operators with a simple space/zone/location-based navigation approach to finding information, including the ability to search for any location by name and to bookmark a location in a standard browser.

d. The mobile user interface shall organize and display information using customer specific locations and spaces. At a minimum, the user interface shall provide:
   1) Organization of all space, equipment and point information in a familiar way (using standard equipment names and location descriptions), reducing the need for extensive training prior to use.
   2) A navigation mechanism or tree for users to select the specific location or space for accessing information – only spaces and locations in the navigation tree or equipment serving that space, nothing more.
   3) The ability to search for and/or bookmark any location, space, or equipment by name for quick access to critical or troublesome areas.
   4) Application of the same navigation mechanisms across any client device (e.g. Smart phone, tablet, personal computer) for consistency and ease of use.

e. The same user interface elements shall be accessible from any type of personal computer or mobile device running any type of operating system supported (e.g. iOS, Android, Windows®). It shall automatically adapt and optimize the display for the screen size and touch screen navigation.

f. Navigation Trees
   1) A dedicated location-based navigation tree shall be provided as part of the user interface in order to navigate to specific places within the facility on a hierarchical basis (typ. Campus, Facility, Building, Wing, Floor, Room.)
   2) The location-based tree shall use place names familiar to the operator without training or familiarization regarding special codes and conventions utilized in the generation of the BAS.
   3) Clicking or tapping on a location name in the tree shall display the home page associated with the space and simultaneously expand the tree to display the next level of spaces below the one selected.
   4) Provide a means for qualified users to view an all hardware items navigation tree of devices connected to the BAS network in order to enable troubleshooting of equipment and communications.
   5) A click or tap on a device in the network tree shall display a dashboard for that device including information regarding related equipment and access to a separate focus view of commandable points associated with the piece of hardware. A click or tap on such a point shall display a control dialogue box allowing the user to modify or command that point as indicated. The dialog box shall contain an annotation box for describing why the action was taken or special circumstances that apply.
   6) Specific hardware and software types in the Network tree shall also include access to one or more the following views in their dashboard depending on hardware type or network element (e.g. MS/TP trunk):
      a) Summary View
      b) Diagnostic View
      c) Network View

d) Trend View

7) Provide a means to hide the Network Tree and return to the Spaces Tree at any time by clicking on the Spaces Icon above the tree.

8) Provide a means to restrict user access to any space in the Spaces Tree and thereby prevent manipulation of equipment associated with the space.

g. Dashboard Displays

1) The user interface shall provide the ability to view equipment visualizations, floor plans, and/or other graphics on mobile or desktop client devices in a browser environment, without the need for additional plugins or software. Graphics shall be accessible via a space (for floorplans, campus maps, etc.) or equipment dashboard.

2) Standard dashboards shall be configured for each defined space including one of the following predefined or custom elements:
   a) Equipment Serving Space
   b) Potential Problem Areas
   c) Equipment Summary
   d) Graphic Display (if specified)
   e) Schedule

3) Standard dashboards shall be configured for each system or device (typ. mechanical or electrical equipment) including the following predefined or custom elements:
   a) Trend
   b) Equipment Activity Summary
   c) Equipment Relationships Summary
   d) Equipment Data
   e) Graphic Display
   f) Schedule

4) Users with appropriate permissions shall have access to a Dashboards Manager that can change the display order of Summaries and Data elements, add or remove elements and apply custom dashboards layouts to equipment and space by type.

5) Dashboard Manager shall apply dashboards to spaces or equipment based on the viewing platform (Desktop/Tablet or Phone) in order to tailor the user experience to the needs of the specific user base.

6) Default dashboard displays by space and equipment type shall be created per the guidelines in this specification or by mutual agreement with the Owner's representative.

h. Alarm Management

1) The user interface shall provide a single display of all potential issues in a facility including items currently in alarm, warning, override, out-of-service and offline.

2) The user interface shall provide notification of new alarms, visually and audibly.

3) The user interface shall provide the ability to view a summary of alarms, including a chart of the number of alarms in each of the defined alarm priority ranges. The priority ranges should be filterable.

4) The user interface shall provide the capability to view multiple occurrences of the same alarm, ultimately providing the ability to acknowledge or discard all occurrences of the alarm in a single action.

5) The user interface shall provide the capability to view, and filter on, all alarms present in a well-defined mechanical system using the equipment serving equipment relationships.
6) The user interface shall provide the capability to acknowledge and discard all occurrences of at least 1000 alarms in one operation.
7) The user interface shall provide the user with the understanding of what physical space is being affected when an alarm occurs. The user interface shall provide the ability to filter alarms by physical space affected when the alarm occurred.
8) The user interface shall provide the capability to monitor alarms 24/7 without requiring an active login to the system, accessible via segregated web page. The user interface shall provide the capability to enabled or disable the 24/7 alarm monitor mode if desired.
9) The user interface shall provide the capability to annotate alarms using a pre-defined selection list or by providing custom text.
10) The user interface shall provide the capability to filter down alarm list and bookmark the filtered list, allowing automatic filtering to be applied when the bookmark is accessed.
11) Provide a means to export a .csv or .pdf copy of the currently displayed alarm list.
12) Provide a means to set up an alarm escalation feature. If an alarm is not acknowledged or discarded by recipients within a user-selected time, the alarm shall be escalated to an additional set of recipients.

i. Send Announcement
1) Administrative users should have the ability to alert staff of planned outages in advance. The communication avenues should include:
a) Email
b) A message shown on the login screen
c) A banner shown to logged in users

j. Equipment Activity Summary
1) The user interface shall provide a filterable, single display, of all activity related to a specific piece of equipment including user changes, discarded user changes, pending alarms, discarded alarms, and acknowledged alarms for at least one year of historical data.
2) Items shall be listed in timed order with the latest activity at the top of the list.
3) Filters shall allow only specific activities for specific data points occurring within a specific time and date window to be displayed.
4) Provide a means to export a .csv copy of the currently displayed summary by clicking or tapping on the export icon.
5) Provide a means to create a custom trend graph containing the data shown in the currently displayed summary by tapping or clicking on the trend icon in the header bar and selecting the specific points to trend in the resulting selection panel.
6) Clicking on the information icon in front of any displayed activity listed in the summary shall expand the display to include the name of the user, server time, value prior to the activity, the ability to annotate the activity and a user selectable icon for displaying a trend graph of the point.

k. Equipment Relationships Summary

1) The user interface shall provide a summary of all equipment and spaces related to the operation of the system or device currently selected for viewing.
2) The user interface shall include the capability to navigate to the home page of any related piece of equipment or space with a single click or tap on the desired element.

l. Equipment Data Summary
1) The user interface shall provide a summary of all data pertaining to a particular piece of mechanical or electrical equipment in a tabular format. Clicking or tapping on any value in the summary shall display a related command panel allowing the user to command, override, or change service condition of the point selected and to annotate such actions for future reference.
2) Provide a means to export a .pdf copy of the report with a single click on the associated export icon.

m. Equipment Serving Space Summary
1) The user interface shall provide a summary of all mechanical and electrical equipment as defined in the points list that serves a selected space from the navigation tree.
2) The summary shall be capable of including a subset of the viewable points for each system representing the key elements of interest to operators without subjecting them to long lists of points irrelevant to basic operation.
3) Clicking or tapping on any item in the summary shall navigate to the item's assigned home page in the user interface.
4) Provide a means to view a custom trend of information contained in the summary with a single click of the trend icon residing in the title header.
5) Provide a means to display specific systems and points by filtering equipment types desired.
6) Because the data is intended to be a snapshot of the current conditions in the space it shall not dynamically update but a click or tap on the update icon at any time performs that function.

n. Potential Problem Areas Summary
1) The user interface shall provide a summary of all points in the system related to the space that are not operating correctly (e.g. alarm, off normal or not communicating correctly) in order to provide the operator with a quick update on current conditions.
2) The information shall include:
a) Point status (via color)
b) Point name
c) Value of the point when the summary was taken
d) Equipment that contains the offending point
e) Space that is served by that equipment
3) Data points in the summary may be filtered by one or more types of off-normal condition (e.g. above setpoint, offline and overridden).
4) The summary may be exported in .csv format for inclusion in spreadsheets or other documents.

o. Equipment Summary
1) The user interface shall provide a summary that allows the user to compare all similar equipment that serves the space as well as downstream (child)

spaces in order to evaluate conditions quickly and determine patterns for troubleshooting purposes.

2) Each unique equipment type shall be selectable and display a representative set of values along with the space(s) being served by the device. Equipment types can be selected from a dropdown menu in the summary.
3) Clicking or tapping on a selected device in the summary shall navigate to the home page for that piece of equipment while clicking or tapping a data point shall display the command panel for that point.
4) Provide a means to export a .pdf copy of the currently displayed summary by clicking or tapping on the export icon.
5) Provide a means to create a custom trend graph containing the data shown in the currently displayed summary by clicking on the trend icon in the header bar and selecting the specific points to trend in the resulting selection panel.
6) Provide a means to sort data within the summary by clicking on the desired column heading, allowing to sort from lowest to highest value or vice versa.
7) Provide a means to edit the column types and column order within the summary to provide relevant information in accordance with Operators' preferences.
8) Provide a means to link to an advanced search and reporting function directly from the Equipment Summary that will pre-populate the advanced report with the data from the Equipment Summary.

p. User Defined Summaries
1) Provide the capability to view, command, and modify large quantities of similar data in summaries without the use of a secondary application (e.g. a spreadsheet). These summaries shall be generated automatically or user defined.

q. Trend
1) The user interface shall provide the capability to view historical trend data from multiple pieces of equipment in both bar and line formats.
2) The user shall have the ability to navigate to a selection list of frequently viewed trends.
3) Trend graphs shall have to ability to be smartly auto-generated based on equipment and space relationships.
4) The user shall have the ability to view up to 3 graphs of differing units of measurement in a single screen and select which data points to plot on each to help with readability.
5) Each graph shall include a dedicated selection icon to export a copy of the graphic and data in .pdf format or the data only as a .csv file.
6) Trend graphs shall allow the plotting of non-trended point's default values.
7) The user shall have the ability to add any trended to point a custom trend graph.
8) The user shall have the ability to save trend graphs for reference later.
9) The user shall be able to specify the duration of time and aggregation period for each trend line.
10) The user shall have the ability to decide whether to show raw or aggregate trend data.

r. Operator Access
1) The user interface shall provide the ability to segment access to building data based on the space(s) or location(s) the user is physically located in and/or manages. The user interface shall provide the capability to assign

"inherited" space permissions and the ability to assign user's space based access in bulk.

2) The user interface shall provide the ability to segment access to building data based on the space(s) or location(s) the user is physically located in and/or manages. The user interface shall provide the capability to assign "inherited" space permissions and the ability to assign user's space based access in bulk.

s. Graphics

1) The user interface shall display an equipment visualization or graphic within the context of its associated space (building, floor, room, etc.) or equipment dashboard.
2) Graphics shall include the ability to define individual information layers for operator selection in order to clarify systems status and simplify operation on mobile devices. Where desired a master layer may be defined to include important information about the facility on all graphic screens.
3) Graphics shall support the use of photo-realistic symbols as well as color change and animation to match the status of the related system control point.
4) Provide a means to export a time stamped .pdf file of the graphic being viewed in order to communicate the current conditions in the space or the equipment being viewed and to provide a historic record.
5) An integral graphic manager shall be provided including the following features and capabilities:
    a) Creation and modification of graphics from any HTML5 capable browser without the need for additional plug-ins or software packages.
    b) Access to a full suite of pre-defined templates for air and water sourced HVAC applications as well as the ability to add custom templates as created for other use. Pre-aliased graphic templates may be defined and saved for repetitive representations of common mechanical and electrical equipment.
    c) A full suite of pre-defined three dimensional symbols for mechanical and electrical systems as well as all line, text and shape tools required for integration into a graphic with zoom and pan capabilities on multiple platforms and in multiple browsers.
    d) The ability to search and replace items in multiple graphics with a single command.
    e) The ability to import and insert photos and images into the graphic.
    f) The ability of the graphics manager to create and edit graphics including the ability to bind graphic elements to the values and conditions of system points in both an on-line and off-line mode.
    g) The ability to create and import custom SVG symbols that can be selectable from the graphical palette and rendered at runtime.
6) As required, the BAS Contractor shall provide software licenses in the name of the owner for programming, configuration and graphics building tools to allow designated representatives to make changes, modifications or additions to the system. While future updates or revisions may require an update fee, the owner shall incur no additional cost if they choose not to update. Systems that require any annual or time-limited licensing fees shall not be permitted.

t. Scheduling

1) The user interface shall provide the capability to display, in a singular view, all of the effective schedules in the context of the space (building/floor/room, etc.) or equipment that the schedule effects. The software should have the ability to display an effective schedule, for the present, or a future date.
2) The user interface shall provide a report of all schedules affecting a space or equipment. The report shall provide the user details of events that comprise the weekly schedule and exception schedule(s). The report shall provide a means of viewing individual breakout scheduling elements for Weekly Schedule, Exceptions and Default Commands.
3) The user interface shall provide the capability to efficiently change or modify schedules in mass quantities. This includes the capability to add, in bulk, exceptions to schedules, in addition to assigning, in bulk, weekly schedules.

u. Command and Control
1) Provide a means to command system analog and binary points via a dropdown menu accessed by clicking or tapping on the value shown in any equipment summary or graphic display and completing the task in the resultant menu including an optional annotation.
2) Commanding multiple points shall be possible on displays where multiple like system elements can be chosen.
3) The user interface shall support users adding notes on their commands.
4) The user interface shall support a choice of either permanent or temporary commands.

v. Involvement
1) The user interface shall provide in a single screen, a way to visualize all interactions (I.e. - commands, writes, references) with a single object.
2) The interface shall provide the ability to filter out any interactions (i.e. commands, writes, references) that are not pertinent.
3) The user interface shall allow seamless navigation between one object's Involvement view to another object's.

w. System-Level Activity
1) The user interface shall provide a timeline view of all audits that occur in the system, including:
a) Logins attempts with user specified
b) Add, delete, modification of objects
c) Commands

x. Search
1) Typing a text string in the Search box shall display a list of all occurrences of that string in the mobile user interface. When a string is represented in the description of a space or network element, selecting it shall display its default dashboard.
2) Clicking or tapping on the Advanced Search Icon shall display the Advanced Search dialog box permitting the following:
a) Search by Space and Equipment, Equipment Definition or Network Reference
b) Filter the search by wildcard name or object type
c) Multi-selection of objects for commanding or the creation of reports including Trend, Alarm, Audit and Activity for a specific period of time

d) Creation of reports in PDF or CSV formats which can be instantaneously downloaded or emailed, or scheduled to be sent at Operator-selected intervals (daily/weekly/monthly)

y. Software Updates
1) Users shall be notified when new software becomes available for download.
2) Users shall be given brief information on what's to be expected in the update.

z. Offline Operation
1) The mobile user interface shall have the ability to operate in an offline mode in order to create or edit graphics and dashboard elements.
2) Content created offline shall be available to all authorized users for inclusion of an operating user interface later.

aa. Fault Detection
1) Fault detection functionality shall be provided that identifies and displays building system-related faults and lists them color coded in order of severity. This software shall leverage defined rules and a semantic data model to ease configuration.
a) The building system fault engine shall run periodically against a minimum of seven days of historical data.

bb. Fault Triage
1) Provide a means to display additional information on a particular fault along with corrective actions in the order of their likeliness to resolve the issue, a description of the fault, charting of supporting data, and an activity log to track progress of triage attempts. Functionality shall enhance the sorting order and information in the Faults display to introduce fault occurrences and durations to better drive the most problematic issues to the top of the list.

D. Associated Application Components
1. Security/Passwords
a. Multiple-level passwords access protection shall be provided via roles and permissions. The feature will allow the system to base access on a user's job title or role and allow the user/manager access interface control, display, and database manipulation capabilities based on an assigned password.
b. Roles may be copied and altered to meet specific roles and permissions based on the particular policies.
c. The system shall allow each user to change his or her password at will.
d. When entering or editing passwords, the system shall not echo the actual characters for display on the monitor.
e. A maximum of 150 categories may be used to determine or assign areas of responsibilities to each user account.
f. A minimum of 100 unique passwords shall be supported.
g. Operators shall be able to perform only those commands available for their respective passwords. Display of menu selections shall be limited to only those items defined for the access level of the password used to log-on.
h. Operators shall be further limited to only access, command, and modify those buildings, systems, and subsystems for which they have responsibility. Provide a minimum of 100 categories of systems to which individual operators may be assigned.

i. The system shall automatically generate a report of log-on/log-off and system activity for each user.
j. The system shall have the ability to provide a Department of Defense (DoD) specific warning banner for applicable sites that warns the user they are accessing a restricted site.
k. After successful login the last time and date that user name was previously logged in is shown on the screen.
l. Each login attempt is recorded in the system Audit Log with the option to record the IP address of the PC that made the login.

2. Screen Manager
   a. The system will allow a customized image on the login screen (e.g. organization name, logo).
   b. User View navigations can be displayed as either a set of tabs or a drop down list.
   c. Allows user preference for assigning of a background color for when an object is Out of Service which will enable the operator to quickly distinguish points that have been commanded to this state.
   d. The User Interface shall be provided with screen management capabilities that allow the user to activate, close, and simultaneously manipulate a minimum of 4 active display windows plus a network or user defined navigation tree.
3. Historical trending and data collection
   a. Each Network Engine shall store trend and point history data for all analog and digital inputs and outputs, as follows:
      1) Any point, physical or calculated, may be designated for trending. Two methods of collection shall be allowed:
         a) Defined time interval
         b) Upon a change of value
   b. Each Network Engine shall have the capability to store multiple samples for each physical point and software variable based upon available memory, including an individual sample time/date stamp. Points may be assigned to multiple history trends with different collection parameters.

2.4 NETWORK CONTROL ENGINE (NCE)

A. Network Control Engine (NCE)
1. The Network Control Engine shall be a fully user-programmable, supervisory controller. The NCE shall monitor the network of equipment controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Engines.
2. The NCE shall also be a fully user-programmable, equipment controller that includes a minimum of 28 I/O points.
3. Automation Network – The NCE(s) shall reside on the automation network and shall support a subnet system controllers via an integral Control network connection.
4. Automation network temporary cellular connection – The BAS shall be provided with a temporary connection via a "master" control engine whereby the Automation network and connected "slave" engines can be accessed remotely before Owner's IT network is operational. This project shall include at least one connected control engine.
   a. The connected control engine shall be a standard catalog product of the BAS manufacturer. Non-standard or custom applications are not acceptable.

b. This connected control engine shall be panel mounted with a cellular modem, remote antenna and antenna cables, 5 port Ethernet switch, and a power supply with convenience outlet,
c. The "master" control engine shall communicate with a temporary Automation Data Server which can be used to remotely load graphics, generate and load database, program, commission and demonstrate the BAS.
d. A one-year cellular contract shall be included within this contract at no additional cost to the Owner. Multiple cellular services shall be made available to choose from to allow for best connection strength at the jobsite. The costs of the remote server shall be included within this contract at no additional cost to the Owner.

5. User Interface – Each Network Control Engine shall have the ability to deliver a web-based User Interface previously described. All computers connected physically or virtually to the automation network shall have access to the web-based user interface.
6. Processor – The NCE(s) shall be microprocessor-based with a minimum word size of 32 bits. The Network Control Engine shall be a multi-tasking, multi-user, and real-time digital control process. Standard operating systems shall be employed. NCE(s) size and capability shall be sufficient to fully meet the requirements of this Specification.
7. Memory – Each NCE shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.
8. Secure Boot – The NCE shall prevent malicious or unauthorized software applications from loading during the system startup process.
9. Background File Transfer – The NCE shall provide the capability to download a new image and database to a network engine while the engine is still running and controlling the building.
10. User Authentication – The NCE shall support local user authentication.
11. Password Security – Access to the Network Control Engines' embedded user interface shall require a password of 8 to 50 characters including a minimum of one lower case letter, one upper case letter, one number, and one special character. An alarm shall be generated after three unsuccessful attempts within 15 minutes and the user shall be denied access until permission is renewed by a system administrator.
12. Network Security – Communication between the NCE and other system networked devices including additional Network Engines, Application and Data Servers, Open Data Servers (BACnet listed OWS), and user interface clients shall be encrypted and support HTTPS with Transport Level Security (TLS) Version 1.2. Self-signed certificates are to be provided with the option of configuring trusted certificates. Engines shall also be equipped to optionally support FIPS 140-2 Federal Government encryption standard.
13. Hardware Real Time Clock – The Network Control Engine shall include an integrated, hardware-based, real-time clock, with a supercapacitor to maintain time for a minimum of 72 hours during a power loss. Controllers using a battery to maintain time during a power loss shall not be acceptable.
14. Diagnostics – The NCE(s) shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The NCE(s) shall provide both local and remote annunciation of any detected component failures or repeated failures to establish communication.
15. Power Failure – In the event of the loss of normal power, the NCE(s) shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.

a. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.
b. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.

16. Certification – The NCE(s) shall meet and be listed to the UL 916 Standard for Energy Management Equipment and be FCC Compliant to CFR47, Part 15, Subpart B, Class A.
17. Device Integration – The NCE(s) shall support integrating and supervising networked devices using the following communication protocols on the device/controller network:
    a. The NCE (s) shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135 on the controller network.
        1) The NCE (s) shall support Remote Field Bus integration via a BACnet IP to MS/TP router.
        2) The NCE (s) shall be tested and BTL listed/certified as a BACnet Building Controller (B-BC).
        3) A BACnet Protocol Implementation Conformance Statement shall be provided for the NCE(s).
    b. The NCE(s) shall optionally support integration of networked devices using the following networking protocols:
        1) BACnet
        2) Johnson Controls N2 or third party N2 Open devices.
        3) LonTalk
        4) MODBUS RTU
        5) MODBUS TCP
        6) KNX
        7) M-Bus
        8) OPC UA
18. The NCE shall employ a finite state programming to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.
19. The NCE shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only, shall not be acceptable.
20. The NCE shall support the following types of inputs and outputs:
    a. Universal Inputs – shall be configured to monitor any of the following for Analog inputs: Voltage Mode, Current Mode, Resistive Mode. For Binary Inputs: Dry Contact Maintained Mode, Pulse Counter Mode
    b. Analog Outputs – shall be configured to output either of the following: Voltage Mode, Current Mode
    c. Binary Outputs – shall output the following: 24VAC Triac
    d. Configurable Outputs – shall be configured to output either of the following: Analog Output Voltage Mode; Binary Output 24 VAC Triac Mode
    e. The NCE shall have the ability to monitor and control a network of sensors and actuators over a Sensor Actuator (SA) Bus dedicated to the controller. This bus shall be a MS/TP Bus supporting BACnet Standard protocol SSPC-135 supporting no less than 9 devices with a maximum distance of 1,200 Ft. between the NCE and the furthest connected device.

21. The NCE shall provide removable, labeled, screw terminal blocks for 24 VAC power, communication bus and I/O point field wiring.
22. The NCE shall include the following multi-color, flashing LEDs to indicate important operating conditions and status
23. Communications Ports – The NCE(s) shall provide the following ports for connecting networkable devices:
    a. Two (2) USB ports
    b. One (1) RS-485 port
    c. Two (2) Ethernet ports
24. The NCE shall support an integrated user interface featuring a display and keypad in lieu of on-board HOA switches for output overrides.
    a. The integrated user interface shall allow viewing and monitoring points, alarms, and trends.
    b. The integrated user interface shall allow viewing and changing setpoints, modes of operation, and parameters.
    c. The integrated user interface shall provide password protection with user-adjustable password timeout.
    d. The information presented by the integrated user interface shall be organized into folders for easy navigation.
    e. The integrated user interface shall support textual descriptions in English for each point.
    f. The display shall be, at minimum, a 2.4-inch, color display with 320x240 resolution.
    g. The display shall support adjustable contrast and brightness.
    h. The keypad shall include no more than seven (7) keys.
25. The NCE shall support up to 50 supervised devices across all supported integrations.

2.5 DDC EQUIPMENT CONTROLLERS

A. General Purpose Application Controller (GPAC)
1. The General Purpose Application Controller (GPAC) shall be a fully programmable, digital controller that communicates via the BACnet MS/TP protocol over the FC Bus.
    a. The GPAC shall support BACnet Standard ANSI/ASHRAE 135.
        1) The GPAC shall be BTL listed/certified.
        2) The GPAC shall be tested and certified as a BACnet Advanced Application Controller (B-AAC).
        3) A BACnet Protocol Implementation Conformance Statement shall be provided for the GPAC.
2. The GPAC shall employ finite state programming to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.
3. GPAC shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only shall not be acceptable.
4. The GPAC shall be assembled in a plastic housing with protection class IP20 (IEC529) and flammability rated to UL94-5VB.

5. The GPAC shall include an integral real-time clock and support time-based tasks which enables these field controllers to monitor and control schedules, calendars, alarms, and trends.
6. The GPAC can continue time-based monitoring when offline for extended periods of time from a network.
7. The GPAC can operate as a stand-alone controller in applications that do not require a networked supervisory device or for network applications where it is preferred to have the scheduling, alarming, and/or trending performed locally in the equipment controllers.
8. The GPAC shall include troubleshooting LEDs to indicate the following conditions normal or abnormal operation of power, controller fault, SA bus communications, FC Bus communications, and end of line on/off.
9. The GPAC shall have the ability to transfer and apply firmware files to all SA Bus devices (EOIM, IOM, and networked zone sensors) connected to it.
10. The GPAC shall include removable and labeled screw terminal blocks for all I/O, FC and SA Bus communication, and power wiring connections.
11. The GPAC shall accommodate the direct wiring of analog and binary I/O field points with the following resolution.
    a. Inputs – 24-bit analog-to-digital converter
    b. Outputs – +/- 200 mV accuracy in 0-10 VDC applications
12. The GPAC shall support the following types of inputs and outputs supplied in the amounts required for the specified applications:
    a. Universal Inputs – 0-10 VDC analog input, 4-20 mA analog input, 0-600k ohms analog input, Dry contact binary input
    b. Binary Inputs – Dry Contact Maintained Mode, Pulse Counter Mode
    c. Analog Outputs – 0-10 VDC analog output, 4-20 mA analog output
    d. Binary Outputs – 24 VAC Triac
    e. Configurable Outputs – 0-10 VDC analog output, 24 VAC Triac binary output
13. The GPAC shall have the ability to monitor and control a network of sensors and actuators over a SA Bus.
14. The GPAC shall include three (3) decimal rotary dial switches for setting the BACnet MS/TP device address.
15. The GPAC shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over a MS/TP Bus.
16. The GPAC shall support a Local Controller Display as a remote device communicating over the SA Bus.
    a. The Display shall use a BACnet Standard SSPC-135 MS/TP protocol.
    b. The Display shall allow the user to view monitored points without logging into the system.
    c. The Display shall allow the user to view and change setpoints, modes of operation, and parameters.
    d. The Display shall provide password protection with user adjustable password timeout.
    e. The Display shall be menu driven with separate paths for:
        1) Input/Output
        2) Parameter/Setpoint
        3) Overrides
    f. The Display shall use easy-to-read English text messages.
    g. The Display shall allow the user to select the points to be shown and in what order.

h. The Display shall support a back lit LCD with adjustable contrast and brightens and automatic backlight brightening during user interaction.
i. The Display shall have a keypad.
j. The Display shall be panel mountable.

2.6 FIELD DEVICES

A. Expansion Input/Output Module (EIOM)
1. The EIOM provides additional input and output interfaces for use in digital controllers.
2. The EIOM shall communicate with controllers over the FC Bus or the SA Bus.
3. The EIOM shall support BACnet Standard ANSI/ASHRAE 135.
   a. The EIOM shall be BTL listed/certified and carry the BTL Label.
   b. The EIOM shall be tested and certified as a BACnet Smart Actuator (B-SA).
   c. A BACnet Protocol Implementation Conformance Statement shall be provided for the IOM.
4. The EIOM shall include removable screw terminal blocks for all I/O, SA/FC bus communication, and power wiring connections.
5. The EIOM shall include three (3) decimal rotary dial switches for setting the BACnet MS/TP device address.
6. The IOM shall accommodate the direct wiring of analog and binary I/O field points with the following resolution:
   a. Inputs – 24-bit analog-to-digital converter
   b. Outputs – +/- 200 mV accuracy in 0-10 VDC applications
7. The EIOM shall support the following types of inputs and outputs:
   a. Universal Inputs – 0-10 VDC analog input, 4-20 mA analog input, 0-600k ohms analog input, Dry contact binary input
   b. Binary Inputs – Dry Contact Maintained Mode, Pulse Counter Mode
   c. Analog Outputs – 0-10 VDC analog output, 4-20 mA analog output
   d. Binary Outputs – 24 VAC Triac
   e. Configurable Outputs – 0-10 VDC analog output, 24 VAC Triac binary output
8. The EIOM shall include troubleshooting LEDs to indicate the following conditions normal or abnormal operation of power, controller fault, SA bus communications, FC Bus communications, and end of line on/off.

B. Networked Thermostat (TEC)
1. The Networked Thermostat shall include an intuitive User Interface providing plain text messages.
   a. Two-line, 8 character backlit display
   b. LED indicators for Fan, Heat, and Cool status
   c. Five (5) User Interface Keys
      1) Mode
      2) Fan
      3) Override
      4) Degrees C/F
      5) Up/Down
2. The Networked Thermostats shall provide the flexibility to support the following inputs:
   a. Integral Indoor Air Temperature Sensor
   b. Duct Mount Air Temperature Sensor

c. Remote Indoor Air Temperature Sensor with Occupancy Override and LED Indicator.
d. Two configurable binary inputs

3. The Networked Thermostats shall provide the flexibility to support the following outputs:
   a. Three Speed Fan Control
   b. On/Off Control
   c. Floating Control
   d. Proportional (0 to 10V) Control

C. Network Sensors (NS)
1. The Network Sensors (NS) shall have the ability to monitor the following variables all within a single wall-mounted enclosure (no exceptions) as required by the systems sequence of operations:
   a. Zone temperature
   b. Zone humidity
   c. Zone carbon dioxide
   d. Zone set point
2. The NS shall transmit the zone information back to the controller on the Sensor-Actuator Bus (SA Bus) using BACnet Standard protocol SSPC-135.
3. The NS shall be BTL listed/certified and carry the BTL Label.
   a. The NS shall be tested and certified as a BACnet Smart Sensors (B-SS).
4. The Network Zone Temperature Sensors shall include the following items:
   a. A backlit LCD to indicate the temperature, humidity and setpoint
   b. An LED to indicate the status of the Override feature
   c. A button to toggle the temperature display between Fahrenheit and Celsius
   d. A button to program the display for temperature or humidity
   e. A button to initiate a timed override command
   f. Available in either surface mount, wall mount, or flush mount
   g. Available with either screw terminals or phone jack

D. VAV Box Controller (VBC)
1. The VAV Box Controller (VBC) shall provide both standalone and networked DDC of pressure independent, VAV terminal units.
2. The VBC controller shall be a fully programmable, digital controller that communicates via BACnet MS/TP protocol over the FC Bus.
   a. The VBC shall support BACnet Standard ANSI/ASHRAE 135.
      1) The VBC shall be BTL listed/certified.
      2) The VBC shall be tested and certified as a BACnet Advanced Application Controller (B-AAC).
      3) A BACnet Protocol Implementation Conformance Statement shall be provided for the VBC.
3. The VBC shall include 14 preloaded single duct VAV box control applications to allow the VBC to be made fully operational without the need to create a custom program.
4. The VBC shall employ finite state programming to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.
5. The VBC shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning

parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only shall not be acceptable.

6. The VBC shall be assembled in a plenum-rated plastic housing with protection class IP20 (IEC529) and flammability rated to UL94-5VB.
    a. The VBC shall include an integral real-time clock and support time-based tasks which enables these equipment controllers to monitor and control schedules, calendars, alarms, and trends
7. The VBC can continue time-based monitoring when offline for extended periods of time from a network.
8. The VBC shall include an integral differential pressure transducer and damper actuator. An additional configuration option shall be available that also includes an integral potentiometer for actual damper position feedback. All components shall be connected and mounted as a single assembly, removable as one piece.
9. The integral damper actuator shall be a fast response stepper motor capable of stroking 90 degrees in 60 seconds for quick damper positioning to speed commissioning and troubleshooting tasks.
10. The VBC shall determine airflow by a state-of-the-art, digital, non-flow pressure sensor that supports automatic correction for polarity on high- and low-pressure DP tube connections to eliminate high- and low-pressure connection mistakes.
11. The VBC shall have the ability to automatically calibrate the flow sensor to eliminate pressure transducer offset error due to ambient temperature / humidity effects.
12. The VBC can operate as a stand-alone controller in applications that do not require a networked supervisory device or for network applications where it is preferred to have the scheduling, alarming, and/or trending performed locally in the equipment controllers.
13. The VBC shall include troubleshooting LEDs to indicate the following conditions normal or abnormal operation of power, controller fault, SA bus communications, FC Bus communications, and end of line on/off.
14. The VBC shall have the ability to transfer and apply firmware files to all SA Bus devices (EOIM, IOM, and Networked zone sensors) connected to it.
15. The VBC shall include removable screw terminal blocks for all I/O, FC and SA Bus communication, and power wiring connections.
16. The VBC shall accommodate the direct wiring of analog and binary I/O field points with the following resolution.
    a. Inputs – 24-bit analog-to-digital converter
    b. Outputs – +/- 200 mV accuracy in 0-10 VDC applications
17. The VBC shall support the following types of inputs and outputs supplied in the amounts required for the specified applications:
    a. Universal Inputs – 0-10 VDC analog input, 4-20 mA analog input, 0-600k ohms analog input, Dry contact binary input
    b. Binary Inputs – Dry Contact Maintained Mode, Pulse Counter Mode
    c. Analog Outputs – 0-10 VDC analog output, 4-20 mA analog output
    d. Binary Outputs – 24 VAC Triac
    e. Configurable Outputs – 0-10 VDC analog output, 24 VAC Triac binary output
18. The VBC shall have the ability to monitor and control a network of sensors and actuators over a SA Bus.
19. The VBC shall include three (3) decimal rotary dial switches for setting the BACnet MS/TP device address.
20. The VBC shall have the capability to execute VAV box control sequences involving direct wired I/O points as well as input and output devices communicating over the SA or FC buses.

21. The controller shall utilize a proportional plus integration (PI) algorithm for the space temperature control loops.
22. Each controller shall continuously, adaptively tune the control algorithms to improve control and controller reliability through reduced actuator duty cycle. In addition, this tuning reduces commissioning costs, and eliminates the maintenance costs of manually re-tuning loops to compensate for seasonal or other load changes.
23. The controller shall provide the ability to download and upload VAV box control application configuration files, both locally and via the FC Bus. Controllers shall be able to be loaded individually or as a group.
24. Control setpoint changes initiated over the network shall be written to VBC non-volatile memory.
25. The VBC controller firmware shall be flash-upgradeable remotely via the FC bus.
26. The VBC controller shall provide fail-soft operation if the airflow signal becomes unreliable, by automatically reverting to a pressure-dependent control mode.
27. The VBC controller shall interface with balancer tools that allow automatic recalculation of box flow pickup gain ("K" factor), and the ability to directly command the airflow control loop to the box minimum and maximum airflow setpoints.
28. The VBC controller shall have on-board diagnostics. These diagnostics shall consist of control loop performance measurements executing at each control loop's sample interval, which may be used to continuously monitor and document system performance. The VBC shall calculate Exponentially Weighted Moving Averages (EWMA) for each of the following metrics, which shall be available to the end user for efficient management of the VAV terminals.
29. The controller shall detect system error conditions to assist in managing the VAV zones.
30. The controller shall provide a flow test function to view damper position vs. flow in a graphical format. The information would alert the user to check damper position. The VBC would also provide a method to calculate actuator duty cycle as an indicator of damper actuator runtime.
31. The VBC controller shall provide a compliant interface for ASHRAE Standard 62-1989 (indoor air quality) and shall be capable of resetting the box minimum airflow based on the percent of outdoor air in the primary air stream.
32. The VBC controller shall comply with ASHRAE Standard 90.1 (energy efficiency) by preventing simultaneous heating and cooling, and where the control strategy requires reset of airflow while in reheat, by modulating the box reheat device fully open prior to increasing the airflow in the heating sequence.

E. System Tools
1. One software copy of each system tool shall be provided with the BAS.
2. System Configuration Tool
    a. The Configuration Tool shall be a software package enabling a computer platform to be used as a stand-alone engineering configuration tool for a Network Engine.
    b. The configuration tool shall provide an archive database for the configuration and application data.
    c. The configuration tool shall provide a site discovery feature to automatically discover field devices on connected buses and networks. Automatic discovery shall be available for the following field devices:
        1) BACnet Devices
        2) LonWorks devices
        3) Johnson Controls N2 Bus devices

d. A wireless access point shall allow a wireless enabled portable PC to make a temporary Ethernet connection to the automation network.
e. Provide Johnson Controls SCT or approved equal.

3. Controller Configuration Tool (CCT)
   a. As part of the single software tool environment including system and controller elements, the Controller Configuration Tool (CCT) shall be used to configure, simulate and commission equipment controllers and NCE controllers.
   b. The CCT shall operate in distinct modes to facilitate efficiency at various steps in the steps leading to project completion as well as future upgrades and maintenance
   c. The configuration tool shall be capable of programming the Equipment Controllers.
      1) The configuration tool shall provide the capability to configure, simulate, and commission the Equipment Controllers.
      2) The configuration tool shall allow the equipment controllers to be run in Simulation Mode to verify the applications.
      3) The configuration tool shall contain a library of standard applications to be used for configuration.
   d. The CCT shall provide multiple options for downloading files to the controllers including direct wired, wireless and Ethernet pass thru as dictated by controller type and location.

2.7 INPUT DEVICES

A. General Requirements
   1. Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.

B. Temperature Sensors
   1. General Requirements:
      a. Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.
      b. The temperature sensor shall be of the resistance type and shall be either two-wire 1000 ohm nickel RTD, or two-wire 1000 ohm platinum RTD.
      c. The following point types (and the accuracy of each) are required, and their associated accuracy values include errors associated with the sensor, lead wire, and A to D conversion:
   2. Room Temperature Sensors
      a. Room sensors shall be constructed for either surface or wall box mounting.
      b. Room sensors shall have the following options when specified:
         1) Set point reset providing a +3 degree (adjustable) range.
         2) Individual heating/cooling set point slide switches.
         3) A momentary override request push button for activation of after-hours operation.
      c. Provide digital display of sensed temperature.
   3. Thermo wells
      a. When thermo wells are required, the sensor and well shall be supplied as a complete assembly, including wellhead and Greenfield fitting.
      b. Thermo wells shall be pressure rated and constructed in accordance with the system working pressure.

c. Thermo wells and sensors shall be mounted in a threadolet or 1/2" NFT saddle and allow easy access to the sensor for repair or replacement.
d. Thermo wells shall be constructed of 316 stainless steel.

4. Outside Air Sensors
   a. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.
   b. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.
   c. Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.
5. Duct Mount Sensors
   a. Duct mount sensors shall mount in an electrical box through a hole in the duct, and be positioned so as to be easily accessible for repair or replacement.
   b. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
   c. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.
6. Averaging Sensors
   a. For ductwork greater in any dimension that 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.
   b. For plenum applications, such as mixed air temperature measurements, a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12-foot long segment.
   c. Capillary supports at the sides of the duct shall be provided to support the sensing string.

C. Humidity Sensors
1. The sensor shall be a solid-state type, relative humidity sensor of the Bulk Polymer Design. The sensor element shall resist service contamination.
2. The humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2-wire isolated loop powered, 4-20 mA, 0-100% linear proportional output.
3. The humidity transmitter shall meet the following overall accuracy, including lead loss and Analog to Digital conversion. 3% between 20% and 80% RH @ 77 Deg F unless specified elsewhere.
4. Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R enclosure with sealtite fittings and stainless steel bushings.
5. A single point humidity calibrator shall be provided, if required, for field calibration. Transmitters shall be shipped factory pre-calibrated.
6. Duct type sensing probes shall be constructed of 304 stainless steel, and shall be equipped with a neoprene grommet, bushings, and a mounting bracket.

D. Carbon Dioxide Sensors
1. Duct Mounted
   a. Sensor shall be remote-mounted diffusion-aspirated, single-beam dual-wavelength sensor type with Infrared (IR) source, sample cell, tunable-interference filter, and IR detector. .
   b. Sensing cell shall be provided with thirty (30) inch cable for duct mounting.

c. Sensor shall produce linear analog 0-1 Volt DC, 4-20 MA, and binary adjustable switch point form C outputs.
d. Range shall be 0-2000 parts per million with accuracy of two (2) percent.
e. Sensor shall be mounted in weather tight enclosure with forty-one (41) degree Fahrenheit to 104 degree Fahrenheit operating temperature.
f. Sensor shall be capable of maintaining calibration within 2% for a one year period of operation.

2. Wall Mounted
a. Sensor shall be wall-mounted diffusion-aspirated, single-beam dual-wavelength sensor type with Infrared (IR) source, sample cell, tunable-interference filter, and IR detector. .
b. Sensing cell shall be provided with thirty (30) inch cable for duct mounting.
c. Sensor shall produce linear analog 0-1 Volt DC, 4-20 MA, and binary adjustable switch point form C outputs.
d. Range shall be 0-2000 parts per million with accuracy of two (2) percent.
e. Sensor shall be mounted in weather tight enclosure with forty-one (41) degree Fahrenheit to 104 degree Fahrenheit operating temperature.
f. Sensor shall be capable of maintaining calibration within 2% for a one year period of operation.

E. Differential Pressure Transmitters
1. General Air and Water Pressure Transmitter Requirements:
a. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.
b. Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.
c. Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device, and shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the balancing Contractor and Owner permanent, easy-to-use connection.
d. A minimum of a NEMA 1 housing shall be provided for the transmitter. Transmitters shall be located in accessible local control panels wherever possible.
2. Low Differential Water Pressure Applications (0" - 20" w.c.)
a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of flow meter differential pressure or water pressure sensing points.
b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
c. .01-20" w.c. input differential pressure range.
d. 4-20 mA output.
e. Maintain accuracy up to 20 to 1 ratio turndown.
f. Reference Accuracy: +0.2% of full span.
3. Medium to High Differential Water Pressure Applications (Over 21" w.c.)
a. The differential pressure transmitter shall meet the low pressure transmitter specifications with the following exceptions:
1) Differential pressure range 10" w.c. to 300 PSI.
2) Reference Accuracy: +1% of full span (includes non-linearity, hysteresis, and repeatability).

b. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.

4. Building Differential Air Pressure Applications (-1" to +1" w.c.)
   a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
   b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
      1) -1.00 to +1.00 w.c. input differential pressure ranges. (Select range appropriate for system application)
      2) 4-20 mA output.
      3) Maintain accuracy up to 20 to 1 ratio turndown.
      4) Reference Accuracy: +0.2% of full span.
5. Low Differential Air Pressure Applications (0" to 5" w.c.)
   a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
   b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
      1) (0.00 - 1.00" to 5.00") w.c. input differential pressure ranges. (Select range appropriate for system application.)
      2) 4-20 mA output.
      3) Maintain accuracy up to 20 to 1 ratio turndown.
      4) Reference Accuracy: +0.2% of full span.
6. Medium Differential Air Pressure Applications (5" to 21" w.c.)
   a. The pressure transmitter shall be similar to the Low Air Pressure Transmitter, except that the performance specifications are not as severe. Differential pressure transmitters shall be provided that meet the following performance requirements:
      1) Zero & span: (c/o F.S./Deg. F): .04% including linearity, hysteresis and repeatability.
      2) Accuracy: 1% F.S. (best straight line) Static Pressure Effect: 0.5% F.S. (to 100 PSIG.
      3) Thermal Effects: <+.033 F.S./Deg. F. over 40□F. to 100□F. (calibrated at 70□F.).
   b. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.

F. Air Flow Monitoring - Fan Inlet Airflow Measuring Station (AFMS)
   1. Subject to compliance with all requirements of this section, provide EBTRON, Inc. Model GTx108-F (basis of design) or approved equal.
   2. Airflow measurement devices shall use the principle of thermal dispersion and provide one self-heated bead-in-glass thermistor and one zero power bead-in-glass thermistor at each sensing node.
      a. Thermal dispersion devices that indirectly heat a thermistor are not acceptable.

b. Vortex shedding airflow measurement devices, pitot tubes, pitot arrays, piezo-rings and other differential pressure measurement devices are not acceptable.

3. General
   a. Provide one AMD for each measurement location provided on the plans, schedules and/or control diagrams to determine the average airflow rate and temperature of each fan at each measurement location.
   b. Each AMD shall be provided with a microprocessor-based transmitter and one or more sensor probes.
      1) Devices that have electronic signal processing components on or in the sensor probe are not acceptable.
   c. Airflow measurement shall be field configurable to determine the average actual or standard mass airflow rate.
      1) Actual airflow rate calculations shall have the capability of being field adjusted by the transmitter for altitudes other than sea level.
   d. Temperature output shall be field configurable to provide either the velocity-weighted duct average temperature or simple arithmetic average temperature.
4. Sensor Probes
   a. Each sensor probe shall consist of one sensor node mounted on a 304 stainless steel block with two adjustable zinc plated steel rods connected to 304 stainless steel pivoting mounting feet.
   b. Sensor node internal wiring connections shall be sealed and protected from the elements and suitable for direct exposure to water.
   c. Each sensor probe shall be provided with an integral, FEP jacket, plenum rated CMP/CL2P, UL/cUL Listed cable rated for exposures from -67°F to 392°F and continuous and direct UV exposure.
      1) Plenum rated PVC jacket cables are not acceptable.
   d. Each sensor probe cable shall be provided with a connector plug with gold plated pins for connection to the transmitter.
   e. Sensor node airflow and temperature calibration data shall be stored in a serial memory chip in the cable connecting plug and not require matching or adjustments to the transmitter.
   f. Each sensor node shall be provided with two bead-in-glass, hermetically sealed thermistors potted in a marine grade waterproof epoxy.
      1) Devices that use epoxy or glass encapsulated chip thermistors are not acceptable.
   g. Each thermistor shall be individually calibrated at a minimum of 3 temperatures to NIST-traceable temperature standards.
   h. Each sensor node shall be individually calibrated to NIST-traceable airflow standards at a minimum of 16 calibration points.
   i. The number of independent sensor nodes provided shall be as follows:
      1) SWSI and DWDI fans: 2 probes x 1 sensor node/per probe in each fan inlet
      2) Fan Arrays (2 to 4 fans):
         a) 2 probes x 1 sensor node per probe in each fan inlet
      3) Fan Arrays (5 to 8 fans): 1 probe x 1 sensor node per probe in each fan inlet.
5. Transmitter
   a. A remotely located microprocessor-based transmitter shall be provided for each measurement location.
   b. The transmitter shall be comprised of a main circuit board and interchangeable interface card.

c. All printed circuit board interconnects, edge fingers, and test points shall be gold plated.
d. All printed circuit boards shall be electroless nickel immersion gold (ENIG) plated.
e. All receptacle plug pins shall be gold plated.
f. The transmitter shall be capable of determining the average airflow rate and temperature of each fan.
    1) Separate integration buffers shall be provided for display airflow output, airflow signal output (analog and network) and individual sensor output (IR-interface).
g. The transmitter shall have startup firmware to facilitate setup of multiple fans and fan areas.
h. The transmitter shall be capable of providing a high and/or low airflow alarm.
i. The transmitter shall be capable of providing individual fan alarming on fan array configurations.
j. The transmitter shall be capable of identifying an AMD malfunction via the system status alarm and ignore any sensor node that is in a fault condition.
k. The transmitter shall be provided with a 16-character, alpha-numeric, LCD display.
    1) The total airflow rate, temperature, airflow alarm, individual fan alarm and system status alarm shall be visible on the display.
l. The transmitter shall be provided with two field selectable (0-5/0-10 VDC or 4-20mA), scalable, isolated and over-current protected analog output signals and either:
    1) one isolated RS-485 (field selectable BACnet MS/TP or Modbus RTU) network connection; or
    2) one isolated Ethernet (simultaneously supported BACnet Ethernet or BACnet IP, Modbus TCP and TCP/IP) network connection. Note: LonWorks capable models shall be provided without analog outputs.
m. Analog signal capability shall include two output terminals: the first, shall provide the total airflow rate; while the second output shall be field configurable to provide one of the following:
    1) temperature
    2) airflow alarm
    3) individual fan alarm; or
    4) system status alarm
n. Network communications shall provide: the total airflow rate, average temperature, individual fan airflow rates, individual fan temperatures, airflow alarm, individual fan alarm, system status alarm, individual sensor node airflow rates, individual sensor node temperatures and fan inlet area.
o. The transmitter shall be powered by 24 VAC and use a switching power supply that is over-current and over-voltage protected.
p. The transmitter shall use a "watchdog" timer circuit to ensure continuous operation in the event of brown-out and/or power failure.

6. Performance
    a. Each sensing node shall have an airflow accuracy of ±2% of reading over an operating range of 0 to 10,000 FPM.
        1) Accuracy shall include the combined uncertainty of the sensor nodes and transmitter.

a) Devices whose overall accuracy is based on individual accuracy specifications of the sensor probes and transmitter shall demonstrate compliance with this requirement over the entire operating range.

b. Each sensing node shall have a temperature accuracy of ±0.15° F over an operating range of -20° F to 160° F°.

7. Install in accordance with manufacturer's placement and installation guidelines.

G. Air Flow Monitoring – Duct Mounted

1. Provide airflow temperature measurement devices where indicated on the plans. Airflow devices shown on HVAC equipment schedules shall be provided and factory installed by the equipment manufacturer. Airflow devices will be as specified in the central control and monitoring specification.
2. Each measuring device shall consist of one or more multi-point measuring probes and a single microprocessor-based transmitter. Each transmitter shall operate on 24VAC.
3. Each sensing point shall independently determine the airflow rate and temperature, which shall be equally weighted and averaged by the transmitter prior to output.
4. Each independent airflow sensor shall have a laboratory accuracy of +/-2% of reading over the entire operating airflow range of 0-5000FPM and be wind tunnel calibrated or verified against standards that are traceable to NIST.
   a. The number of sensor housings provided for each location shall be:

Duct or Plenum Area (ft^2)	**Total # Nodes / Location**
< 2	4
2 to < 4	6
4 to < 8	8
8 to <16	12
≥ 16	16

5. The transmitter shall be capable of communicating with the host controls using the following interface options:
   a. Linear analog output signal: Field selectable, fuse protected and isolated, 0-10VDC and 4-20mA (4 wire)
   b. RS-485: Field selectable N2 Bus
6. Acceptable Manufacturers: Ebtron

H. Air Flow Monitoring – Outdoor Air Hood

1. Provide airflow temperature measurement device for installation in the outdoor air hood (with adjustable standoff) of rooftop packaged air handling unit. Provide where indicated on the drawings, upstream of the outdoor damper.
2. Each measuring device shall consist of one or more multi-point measuring probes and a single microprocessor-based transmitter. Each transmitter shall operate on 24VAC.
3. Each sensing point shall independently determine the airflow rate and temperature, which shall be equally weighted and averaged by the transmitter prior to output.
4. General
   a. Probe and Sensor Node Configurations
      1) 1 probe x 1 sensor node

2) 2 probes x 1 sensor node/probe

b. Installed Airflow Accuracy
1) In Openings Less or Equal to 8 sq.ft.: ±(3% to 15%), typical.
2) In Openings Greater Than 8 sq.ft.: Not recommended.

c. Sensor Node Averaging Method
1) Airflow: Independent (arithmetic average on 2 sensor configurations installed at a single measurement location).
2) Temperature: Independent, velocity weighted average on 2 sensor configurations installed at a single measurement location.

d. Listings and Compliance
1) UL: 60730-1, 60730-2-9; CAN E60730-1, E60730-2-9 (EF-A2000-U Only).
2) FCC: This device complies with Part 15 of the FCC rules.
3) RoHS: This device is RoHS2 compliant.

e. Environmental Limits
1) Temperature:
a) Probes 0 to 2,000 fpm: -20 to 160 ºF.
b) Probes 0 to 3,000 fpm: 0 to 160 ºF .
c) Transmitter: -20 to 120 ºF.
2) Humidity: (non-condensing).
a) Probes: 0 to 100%.
b) Transmitter: 5 to 95%.

5. Individual Sensing Nodes
a. Sensing Node Sensors
1) Self-heated sensor: Precision, hermetically sealed, bead-in-glass thermistor probe.
2) Temperature sensor: Precision, hermetically sealed, bead-in-glass thermistor probe.

b. Sensing Node Housing
1) Material: Glass-filled Polypropylene.
2) Sensor Potting Materials: Waterproof marine epoxy.

c. Sensing Node Internal Wiring
1) Type: Kynar® coated copper.

d. Airflow Measurement
1) Accuracy: ±3% of reading (typical), 4% max. to NIST-traceable airflow standards (includes transmitter uncertainty).
2) Calibrated Range: 0 to 3,000 fpm.
3) Calibration Points: 7.

e. Temperature Measurement
1) Accuracy: ±0.15 ºF to NIST-traceable temperature standards (includes transmitter uncertainty).

6. Sensor Probe Assembly
a. Tube
1) Material: Mill finish 6063 aluminum.

b. Mounting Brackets
1) Material: 304 stainless steel.

c. Mounting Type & Overall Probe Length
1) Insertion: 6, 8 or 16 in. (adjustable).
2) Stand-off: 6, 8 or 16 in. (adjustable).

d. Probe to Transmitter Cables

1) Type: FEP jacket, plenum rated CMP/CL2P, UL/cUL listed, -67 to 302 ºF, UV tolerant.
2) Standard Lengths: 10, 25 and 50 ft.
3) Connecting Plug: 0.60" nominal diameter.

7. Transmitter
   a. Power Requirement: 24 VAC (22.8 to 26.4 under load) @8V-A.
   b. User Interface: 16-character LCD display and 4 button interface.
   c. BAS Connectivity:
      1) EF-N2000 Transmitter: One field selectable (BACnet MS/TP or Modbus RTU) and non-isolated RS-485 network connection. Individual sensor node airflow rates and temperatures shall be available via the network (provide individual 24 VAC transformers for each EF-N2000 transmitter for applications requiring isolated RS-485).
   d. Relay
      1) Type: Dry Contact w/ onboard jumper to drive a remote LED (R1=alarm).
      2) Status: N.O. or N.C. via user setup configuration.
      3) Rating: 30 VDC or 24 VAC @ 3 amp. max.
   e. Airflow Alarm
      1) Type: Low and/or high user defined setpoint alarm.
      2) Tolerance: User defined % of setpoint.
      3) Delay: User defined.
      4) Zero Disable: Alarm can be disabled when the airflow rate falls below the low limit cutoff value (unoccupied periods).
      5) Reset Method: Manual or automatic.
      6) Visual Indication: Yes, LCD display.
      7) Network Indication: Yes (EF-N2000 only).
      8) Analog Signal Indication: Yes, on AO2 assignment (EF-A2000 only).
      9) Contact Closure Relay: Yes, on R1 assignment.
   f. System Status Alarm
      1) Type: Sensor diagnostic system trouble indication.
      2) Visual Indication: Yes, LCD display.
      3) Network Indication: Yes (EF-N2000 only).
      4) Analog Signal Indication: Yes, on AO2 assignment (EF-A2000 only).
      5) Contact Closure Relay: Yes, on R1 assignment.
8. Install in accordance with manufacturer's placement and installation guidelines.
9. Basis of Design: Ebtron EB-Flow II EF-x2000-U

I. Water Flow Meters
   1. Insertion Turbine Flowmeters:
      a. Basis-of-Design Product: Subject to compliance with requirements, provide ONICON Model F-1100 or comparable product by one of the following:
         1) ABB
         2) Dynasonics
         3) EMCO Flow Systems
         4) ERDCO Engineering Corp
         5) Hoffer Flow Controls, Inc
         6) ONICON Incorporated
      b. Description: Flowmeter with sensor and indicator.
      c. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.

d. Sensor: Impeller turbine; for inserting in pipe fitting or for installing in piping and measuring flow directly in gallons per minute.
   1) Design: Device or pipe fitting with inline turbine and integral direct-reading scale for water.
   2) Construction: Electroless nickel plated brass or stainless-steel body, with plastic turbine or impeller.
   3) Electronics Enclosure: Weathertight aluminum enclosure
   4) Minimum Pressure Rating: 200 psig.
   5) Minimum Temperature Rating: 180 deg F.
e. Accuracy: Plus or minus 1 percent.
f. Pressure Drop: Less than 1 PSI at 20 ft/s in 1½" pipe, decreasing in larger pipes and lower velocities.
g. Display: Shows rate of flow, with register to indicate total volume in gallons.
h. Output Signals Provided: Frequency Output 0 – 15 V peak pulse.
i. Operating Instructions: Include complete instructions with each flowmeter.

J. Power Monitoring Devices
1. Current Measurement (Amps)
   a. Current measurement shall be by a combination current transformer and a current transducer. The current transformer shall be sized to reduce the full amperage of the monitored circuit to a maximum 5 Amp signal, which will be converted to a 4-20 mA DDC compatible signal for use by the Facility Management System.
   b. Current Transformer – A split core current transformer shall be provided to monitor motor amps.
      1) Operating frequency – 50 - 400 Hz.
      2) Insulation – 0.6 Kv class 10Kv BIL.
      3) UL recognized.
      4) Five amp secondary.
      5) Select current ration as appropriate for application.
2. Current Transducer – A current to voltage or current to mA transducer shall be provided. The current transducer shall include:
   a. 6X input over amp rating for AC inrushes of up to 120 amps.
   b. Manufactured to UL 1244.
   c. Accuracy: +.5%, Ripple +1%.
   d. Minimum load resistance 30kOhm.
   e. Input 0-20 Amps.
   f. Output 4-20 mA.
   g. Transducer shall be powered by a 24VDC regulated power supply (24 VDC +5%).

K. Power and Energy Meters:
1. Power meters shall be furnished by BAS contractor, installed and wired by the electrical contractor. Communication trunk from the BAS and integration with the BAS shall be provided by the BAS contractor. Power meter(s) shall be compatible with the Building Automation System (BAS) provided under Division 23. Refer to Electrical
2. The power meter shall be fully electronic with multi-line backlit LCD display showing measured parameters as well as alarm functions and pulse output.
3. The power meter shall perform the following measurements:
   a. Accumulated Real Energy (kWh) for each phase and total of all phases
   b. Accumulated Reactive Energy (kVARh) and Apparent Energy (kVAh) totals for all phases

c. Net Present Demand for Real (kW), Reactive (kVAR) and Apparent (kVA) Power over a user-specified interval (block or sliding window)
d. Maximum (Peak) Real (kW), Reactive (kVAR) and Apparent (kVA) Demand Intervals
e. Instantaneous Real (kW), Reactive (kVAR) and Apparent Power (kVA), by phase and in total
f. Current (amps) for each phase and average of all phases
g. Phase-to-phase voltage for each phase and average of all phase pairs
h. Phase-to-neutral voltage for each phase pair and average of all phases
i. Power factor for each phase and average of all phases
j. AC frequency

4. The power meter shall communicate using the BACnet MS/TP protocol at speeds from 9600 to 115,200 baud (no parity). The meter shall provide a BACnet Device object, a set of writable Analog Value objects for remote configuration, a set of Analog_Input objects to provide access to scaled 32-bit measurement values and their unit types, and a set of Binary Input objects for indicating individual alarm conditions.
5. The meter shall be UL/CUL listed to the latest applicable safety standards.
6. Power meter models shall accept voltage input over the range of 90 to 600 VAC (50 or 60 Hz).
7. The power meter shall accept 0 to 0.333VAC input from up to three current transducers (U018 Rope Style CTs only) from 20 to 5000 amps.
8. The measured energy consumption shall be retained in non-volatile memory for the life of the product warranty.
9. The power meter shall have demand measurement programmable for up to 6 sub-intervals of 10 seconds to 546 minutes duration.
10. Meter shall be optionally available in an outdoor NEMA 4X enclosure.
11. The power meter shall operate from -30°C to +70°C.
12. The power meter shall have dimensions not exceeding 4.2" x 3.6" x 2.3".
13. The power meter shall meet both ANSI C12.20 .5% and IEC 62053-22 Class .5S real power and energy accuracy specifications.
14. The power meter shall meet IEC 62053-22 Class 2 reactive power and energy accuracy specifications.
15. The power meter shall be configurable for operation on Single Phase (AN or AB), Split Phase (ABN), Delta (ABC), and Wye (ABCN) systems.
16. The power meter shall have automatic phase reversal compensation such that it is insensitive to the CT's load orientation.
17. The power meter shall have separate control power inputs such that is may be powered from a different service than it measures.
18. The power meter shall have Phase Loss Alarm contacts with a user configurable phase loss threshold.
19. The power meter shall have a user-configurable Pulse Contact input to support measurement of other related energy (Gas, Water, Steam, etc.) via BACnet using a simple pulse-output transducer.
20. The power meter shall be configurable for use with Potential Transformers to 5000 volts.
21. The power meter shall support warnings for low power factor (phase current or voltage miss-wired), current over range, voltage over range, and frequency out of range.
22. The product shall have a 5-year warranty.
23. The power meter shall be Veris E50H2 or equivalent.

L. Status and Safety Switches

1. General Requirements
   a. Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the BAS when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.
2. Current Sensing Switches
   a. The current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.
   b. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.
   c. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.
3. Air Filter Status Switches
   a. Differential pressure switches used to monitor air filter status shall be of the automatic reset type with SPDT contacts rated for 2 amps at 120VAC.
   b. A complete installation kit shall be provided, including: static pressure tops, tubing, fittings, and air filters.
   c. Provide appropriate scale range and differential adjustment for intended service.
4. Air Flow Switches
   a. Differential pressure flow switches shall be bellows actuated mercury switches or snap acting micro-switches with appropriate scale range and differential adjustment for intended service.
5. Air pressure safety switches shall be of the manual reset type with SPDT contacts rated for 2 amps at 120VAC.
   a. Pressure range shall be adjustable with appropriate scale range and differential adjustment for intended service.
6. Low Temperature Limit Switches
   a. The low temperature limit switch shall be of the manual reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120VAC.
   b. The sensing element shall be a minimum of 15 feet in length and shall react to the coldest 18-inch section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.
   c. For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.

2.8 OUTPUT DEVICES

A. Actuators
   1. General Requirements
      a. Damper and valve actuators shall be electronic. Controls submittals shall indicate actuator fail position as normally open or closed.
   2. Electronic Damper Actuators
      a. Electronic damper actuators shall be direct shaft mount.

b. Modulating and two-position actuators shall be provided as required by the sequence of operations. Damper sections shall be sized Based on actuator manufacturer's recommendations for face velocity, differential pressure and damper type. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the dampers, as required. All actuators (except terminal units) shall be furnished with mechanical spring return unless otherwise specified in the sequences of operations. All actuators shall have external adjustable stops to limit the travel in either direction, and a gear release to allow manual positioning.

c. Modulating actuators shall accept 24 VAC or VDC power supply, consume no more than 15 VA, and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA, and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal and may be used to parallel other actuators and provide true position indication. The feedback signal of one damper actuator for each separately controlled damper shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.

d. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Isolation, smoke, exhaust fan, and other dampers, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop associated fan. Two-position actuators, as specified in sequences of operations as "quick acting," shall move full stroke within 20 seconds. All smoke damper actuators shall be quick acting.

3. Electronic Valve Actuators

a. Electronic valve actuators shall be manufactured by the valve manufacturer.

b. Each actuator shall have current limiting circuitry incorporated in its design to prevent damage to the actuator.

c. Modulating and two-position actuators shall be provided as required by the sequence of operations. Actuators shall provide the minimum torque required for proper valve close-off against the system pressure for the required application. The valve actuator shall be sized Based on valve manufacturer's recommendations for flow and pressure differential. All actuators shall fail in the last position unless specified with mechanical spring return in the sequence of operations. The spring return feature shall permit normally open or normally closed positions of the valves, as required. All direct shaft mount rotational actuators shall have external adjustable stops to limit the travel in either direction.

d. Modulating Actuators shall accept 24 VAC or VDC and 120 VAC power supply and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal, and may be used to parallel other actuators and provide true position indication. The feedback signal of each valve actuator (except terminal valves) shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.

e. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Butterfly isolation and other valves, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop the associated pump or chiller.

B. Control Relays

1. Control Pilot Relays

a. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.
b. Mounting Bases shall be snap-mount.
c. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.
d. Contacts shall be rated for 10 amps at 120VAC.
e. Relays shall have an integral indicator light and check button.

C. Control Valves (Chilled Water)
1. All modulating control valves shall be of the "pressure independent" type configured with one integrated valve body that incorporates one chamber with an adjustable Cv and a separate pressure regulating chamber used to maintain a constant differential pressure across the control surface.
2. Each control valve shall be individually flow tested at the factory and verified to deviate no more than ±5% through the selected operating pressure range. A calibrated performance tag shall be provided with each valve that verifies the flow rate in 10° rotation increments up to full rated flow (option with 1/2"). All testing shall be performed with instruments calibrated to the requirements of ANSI/ISA-S75.11-1985, with traceability to NIST and/or ISO standards.
3. Control valve rangeability shall be 50:1 minimum.
4. Each control valve shall be subjected to 70 psid and tested to exceed ANSI/FCI 70-2-1998 leakage ratings. Class IV leakage or better is required for control valves 2" nominal size and less. Class III leakage or better is required for control valves larger than 2".
5. In all control valves 8" and smaller, it shall be possible to modify the valve flow characteristics without removing the valve from the piping system.
6. Balancing valves and associated balancing shall not be required where pressure independent modulating control valves are installed.
7. The control valve actuator shall modulate all valves up to 8" in nominal size from 0 to 100% design flow while rotating the valve stem a maximum of 90°.
8. There shall be three ports installed at the factory integral to each valve and capable of being used to measure pressure or temperature. The first port shall be installed at the inlet to the valve. The second shall be installed between the Cv chamber and the pressure regulating chamber. The third shall be installed at the outlet of the valve. Should the ports not be provided as part of the valve body than they shall be installed in a spool piece and attached to the body.
9. The differential pressure between the first and the third port shall be used in commissioning to verify that the minimum differential pressure (typically 5 psid) required for pressure independent operation is available.
10. The differential pressure between the first and second ports shall be used to verify proper valve operation and flow regulation. It shall be possible to verify the flow rate through the control valve using the valve stem position and the differential pressure measurement between the first and second port in the valve. If these valve features are not available, a flow meter shall be installed to verify actual flow rate in operation through the valve.
11. CB valves to be standard modulating.
12. All valves shall be warranted by the manufacturer for no less than 3 years from the date of purchase.
13. Acceptable manufacturers: Belimo, Brae, Danfoss, Delta Flow.

D. Control Valves (Hot Water & Steam Systems)
1. All automatic control valves shall be "pressure independent" type, fully proportioning and provide near linear heat transfer control. The valves shall be quiet in operation and

fail-safe open, closed, or in their last position. All valves shall operate in sequence with another valve when required by the sequence of operations. All control valves shall be sized by the control manufacturer, and shall be guaranteed to meet the heating and cooling loads, as specified. All control valves shall be suitable for the system flow conditions and close against the differential pressures involved. Body pressure rating and connection type (sweat, screwed, or flanged) shall conform to the pipe schedule elsewhere in this Specification.

2. Hot water control valves shall be modulating plug, ball, and/or butterfly, as required by the specific application. Modulating water valves shall be sized per manufacturer's recommendations for the given application. In general, valves (2 or 3-way) serving variable flow air handling unit coils shall be sized for a pressure drop equal to the actual coil pressure drop, but no less than 5 PSI. Valves (3-way) serving constant flow air handling unit coils with secondary circuit pumps shall be sized for a pressure drop equal to 25% the actual coil pressure drop, but no less than 2 PSI. Mixing valves (3-way) serving secondary water circuits shall be sized for a pressure drop of no less than 5 PSI. Valves for terminal reheat coils shall be sized for a 2 PSIG pressure drop, but no more than a 5 PSI drop.
3. Ball valves shall be used for hot and chilled water applications, water terminal reheat coils, radiant panels, unit heaters, package air conditioning units, and fan coil units except those described hereinafter.
4. Modulating plug water valves of the single-seat type with equal percentage flow characteristics shall be used for all special applications as indicated on the valve schedule. Valve discs shall be composition type. Valve stems shall be stainless steel.
5. Butterfly valves shall be acceptable for modulating large flow applications greater than modulating plug valves, and for all two-position, open/close applications. In-line and/or three-way butterfly valves shall be heavy-duty pattern with a body rating comparable to the pipe rating, replaceable lining suitable for temperature of system, and a stainless steel vane. Valves for modulating service shall be sized and travel limited to 50 degrees of full open. Valves for isolation service shall be the same as the pipe. Valves in the closed position shall be bubble-tight.
6. All valves shall be warranted by the manufacturer for no less than 3 years from the date of purchase.
7. Acceptable manufacturers: Erie, Danfoss, Delta Flow

2.9 MISCELLANEOUS DEVICES

A. Local Control Panels

1. All control panels shall be factory constructed, incorporating the BAS manufacturer's standard designs and layouts. All control panels shall be UL inspected and listed as an assembly and carry a UL 508 label listing compliance. Control panels shall be fully enclosed, with perforated sub-panel, hinged door, and slotted flush latch.
2. In general, the control panels shall consist of the DDC controller(s), display module as specified and indicated on the plans, and I/O devices—such as relays, transducers, and so forth—that are not required to be located external to the control panel due to function. Where specified the display module shall be flush mounted in the panel face unless otherwise noted.
3. All I/O connections on the DDC controller shall be provide via removable or fixed screw terminals.

4. Low and line voltage wiring shall be segregated. All provided terminal strips and wiring shall be UL listed, 300-volt service and provide adequate clearance for field wiring.
5. All wiring shall be neatly installed in plastic trays or tie-wrapped.
6. A convenience 120 VAC duplex receptacle shall be provided in each enclosure, fused on/off power switch, and required transformers.

B. Thermostats
1. Electric room thermostats of the heavy-duty type shall be provided for unit heaters, cabinet unit heaters, and ventilation fans, where required. All these items shall be provided with concealed adjustment. Finish of covers for all room-type instruments shall match and, unless otherwise indicated or specified, covers shall be manufacturer's standard finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. Verify compatibility with and suitability of substrates.

B. Examine roughing-in for products to verify actual locations of connections before installation.
1. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
2. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where product will be installed.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2 BAS SPECIFIC REQUIREMENTS

A. Graphic Displays
1. Provide a color graphic system flow diagram display for each system with all points as indicated on the point list. All terminal unit graphic displays shall be from a standard design library.
2. User shall access the various system schematics via a graphical penetration scheme and/or menu selection.

B. Actuation / Control Type
1. Primary Equipment
a. Controls shall be provided by equipment manufacturer as specified herein.

b. All damper and valve actuation shall be electric.

2. Air Handling Equipment
   a. All air handers shall be controlled with a HVAC-DDC Controller
   b. All damper and valve actuation shall be electric.
3. Terminal Equipment:
   a. Terminal Units (VAV, FCU etc.) shall have electric damper and valve actuation.
   b. All terminal units shall be controlled with HVAC-DDC Controller.

3.3 INSTALLATION

A. BAS Wiring

1. All conduit, wiring, accessories and wiring connections required for the installation of the Building Automation, as herein specified, shall be provided by the BAS Contractor unless specifically shown on the Electrical Drawings under Division 26 Electrical. All wiring shall comply with the requirements of applicable portions of Division 26 and all local and national electric codes, unless specified otherwise in this section.
2. All BAS wiring materials and installation methods shall comply with BAS manufacturer recommendations.
3. The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the BAS Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the BAS Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.
4. Class 2 Wiring
   a. All Class 2 (24VAC or less) wiring shall be installed in conduit.
   b. Concealed, inaccessible wiring shall be installed in conduit and routed to above nearest accessible ceiling.
   c. Concealed, accessible wiring does not need to be installed in conduit but shall be plenum rated.
   d. Conduit shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements.
5. Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.
6. Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.

B. BAS Raceway

1. All wiring shall be installed in blue conduit or raceway except as noted elsewhere in this specification. Minimum control wiring conduit size 1/2".
2. Where it is not possible to conceal raceways in finished locations, surface raceway (wiremold) may be used as approved by the Architect.
3. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.
4. Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls. Flexible Metal Conduit shall be UL listed.

C. Penetrations

1. Provide fire stopping for all penetrations used by dedicated BAS conduits and raceways.
2. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.
3. All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway.
4. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.

D. BAS Panel Installation
1. The BAS panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.
2. The BAS contractor shall be responsible for coordinating panel locations with other trades and electrical and mechanical contractors.

E. Input Devices
1. All Input devices shall be installed per the manufacturer recommendation.
2. Locate components of the BAS in accessible local control panels wherever possible.

F. HVAC Input Devices – General
1. All Input devices shall be installed per the manufacturer recommendation.
2. Locate components of the BAS in accessible local control panels wherever possible.
3. The mechanical contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.
4. Input Flow Measuring Devices shall be installed in strict compliance with ASME guidelines affecting non-standard approach conditions.
5. Outside Air Sensors
    a. Sensors shall be mounted on the North wall to minimize solar radiant heat impact or located in a continuous intake flow adequate to monitor outside air conditions accurately.
    b. Sensors shall be installed with a rain proof, perforated cover.
6. Water Differential Pressure Sensors
    a. Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device.
    b. Differential pressure transmitters shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.
    c. The transmitters shall be installed in an accessible location wherever possible.
7. Medium to High Differential Water Pressure Applications (Over 21" w.c.):
    a. Air bleed units, bypass valves and compression fittings shall be provided.
8. Building Differential Air Pressure Applications (-1" to +1" w.c.):
    a. Transmitters exterior sensing tip shall be installed with a shielded static air probe to reduce pressure fluctuations caused by wind.
    b. The interior tip shall be inconspicuous and located as shown on the drawings.
9. Duct Temperature Sensors:
    a. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
    b. The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
    c. For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.

d. The sensor shall be mounted to suitable supports using factory approved element holders.

10. Space Sensors:
    a. Shall be coordinated with Architectural plans and mounted per ADA requirements.
    b. In public areas and/or where indicated on plans, provide sensors without controls interface, and/or a lockable interface.
    c. Space air temperature sensors shall be provided in all Electrical, AV, IT, Data, Telecom (TR) and Server rooms. Sensors shall be provided with digital display of sensed temperature.
11. Low Temperature Limit Switches:
    a. Install on the discharge side of the first water or steam coil in the air stream.
    b. Mount element horizontally across duct in a serpentine pattern insuring each square foot of coil is protected by 1 foot of sensor.
    c. For large duct areas where the sensing element does not provide full coverage of the air stream, provide additional switches as required to provide full protection of the air stream.
12. Air Differential Pressure Status Switches:
    a. Static pressure tips, tubing, fittings, and air filter.
13. Water Differential Pressure Status Switches:
    a. with shut off valves for isolation.
14. Do not cover or conceal sensors with insulation.

G. HVAC Output Devices
1. All output devices shall be installed per the manufacturer's recommendation. The mechanical contractor shall install all in-line devices such as control valves, dampers, airflow stations, pressure wells, etc.
2. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke. When any pneumatic actuator is sequenced with another device, pilot positioners shall be installed to allow for proper sequencing.
3. Control Valves:
    a. Shall be sized for proper flow control with equal percentage valve plugs. The maximum pressure drop for water applications shall be 5 PSI. The maximum pressure drop for steam applications shall be 7 PSI.
    b. Install valves in piping with stems as vertical as possible but in no case less than forty-five (45) degrees from vertical. For soldered or welded connections, remove valve internals before installation.
    c. Wire electric valves in accordance with NFPA 70 with not less than two (2) feet of flexible liquidtight connector with watertight bushings at the valve actuator and conduit termination. Brace conduit to the building structure to prevent movement and damage.
4. Electronic Signal Isolation Transducers: Whenever an analog output signal from the Building Automation is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input a signal from a remote system, provide a signal isolation transducer. Signal isolation transducer shall provide ground plane isolation between systems. Signals shall provide optical isolation between systems.

H. Label Installation
1. Install or permanently fasten labels on each major item of temperature control equipment.
2. Locate labels where accessible and visible.

3. For equipment, devices, sensors, etc. located above the ceiling, in addition to a label on the equipment, labels are to be permanently affixed to the ceiling grid framing as near to the item as possible using epoxy glue. Where hard ceilings are used, the label is to be affixed to the frame of the access panel for the unit.

3.4 TRAINING

A. The manufacturer shall provide factory trained instructor to give full instruction to designated personnel in the operation of the system installed. Instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach. The manufacturer shall provide all students with a student binder containing product specific training modules for the system installed. All training shall be held during normal working hours of 8:00 am to 4:30 PM weekdays.

B. Provide training for Owner's designated operating personnel. Training shall include:
1. Explanation of drawings, operations and maintenance manuals
2. Walk-through of the job to locate control components
3. Operator workstation and peripherals
4. DDC controller and ASC operation/function
5. Operator control functions including graphic generation and field panel programming
6. Explanation of adjustment, calibration and replacement procedures
7. Electronic Catalog and Materials

C. Since the Owner may require personnel to have more comprehensive understanding of the hardware and software, additional training must be available from the Manufacturer. If such training is required by the Owner, it will be contracted at a later date.

3.5 COMMISSIONING, TESTING AND ACCEPTANCE

A. Perform a three-phase commissioning procedure consisting of field I/O calibration and commissioning, system commissioning and integrated system program commissioning. Document all commissioning information on commissioning data sheets which shall be submitted prior to acceptance testing. Commissioning work which requires shutdown of system or deviation from normal function shall be performed when the operation of the system is not required. The commissioning must be coordinated with the owner and construction manager to ensure systems are available when needed. Notify the operating personal in writing of the testing schedule so that authorized personnel from the owner and construction manager are present throughout the commissioning procedure.
1. Prior to system program commissioning, verify that each control panel has been installed according to plans, specifications, and approved shop drawings. Test, calibrate and bring online each control sensor and device. Commissioning to include, but not be limited to:
a. Sensor accuracy at 10, 50 and 90% of range.
b. Sensor range.
c. Verify analog limit and binary alarm reporting.
d. Point value reporting.
e. Binary alarm and switch settings.
f. Actuator ranges.
g. Fail safe operation on loss of control signal, electric power, network communications.

B. After control devices have been commissioned (i.e. calibrated, tested and signed off), each BAS program shall be put on line and commissioned. The contractor shall, in the presence of the owner and construction manager, demonstrate each programmed sequence of operation and compare the results in writing. In addition, each control loop shall be tested to verify proper response and stable control, within specified accuracies. System program test results shall be recorded on commissioning data sheets and submitted for record. Any discrepancies between the specification and the actual performance will be immediately rectified and retested.

C. After all BAS programs have been commissioned, the contractor shall verify the overall system performance as specified. Tests shall include, but not be limited to:
1. Data communication, both normal and failure modes.
2. Fully loaded system response time.
3. Impact of component failures on system performance and system operation.
4. Time/Date changes.
5. End of month/ end of year operation.
6. Season changeover.
7. Global application programs and point sharing.
8. System backup and reloading.
9. System status displays.
10. Diagnostic functions.
11. Power failure routines.
12. Battery backup.
13. Smoke Control, stair pressurization, stair, vents, in concert with Fire Alarm System testing.
14. Testing of all electrical and HVAC systems with other division of work.

D. Submit for approval, a detailed acceptance test procedure designed to demonstrate compliance with contractual requirements. This Acceptance test procedure will take place after the commissioning procedure but before final acceptance, to verify that sensors and control devices maintain specified accuracies and the system performance does not degrade over time.

E. Using the commissioning test data sheets, the contractor shall demonstrate each point. The contractor shall also demonstrate all system functions. The contractor shall demonstrate all points and system functions until all devices and functions meet specification.

F. The contractor shall supply all instruments for testing.
1. Test Instrument Accuracy:
   a. Temperature: ¼ °F or ½% full scale, whichever is less.
   b. High Pressure: ½ psi or ½% full scale, whichever is less.
   c. Low Pressure: ½% full scale
   d. Humidity: 2% RH
   e. Electrical: ¼% full scale

G. After the above tests are complete and the system is demonstrated to be functioning as specified, a thirty-day performance test period shall begin. If the system performs as specified throughout the test period, requiring only routine maintenance, the system shall be accepted. If the system fails during the test, and cannot be fully corrected within eight hours, the owner may request that performance tests be repeated.

3.6 TEMPERATURE CONTROL

A. The control sequence of operations describe the general operational intent of the control systems. Provide all hardware, software, devices, equipment and wiring as required to perform the operational intent described by the various control sequences and to fully interface with the building automation system (BAS).

B. The control diagrams indicate the general arrangement of system components to the extent that they affect process flow or control. Not all required components are shown on the control diagrams. The contractor shall thoroughly review all contract documents to ascertain the full scope of their work.

C. A full communication interface and complete interoperability with the BAS shall be provided to perform the functions herein described or indicated in the contract documents.

D. For equipment with factory controllers:
   1. The BAS provider and the equipment manufacturer shall provide a complete list of all BACNET points available to be accessed from within the manufacturer's factory controllers and, specifically, identify what points can be read from the BAS, which points can be written too and which points cannot be accessed at all.
   2. The BAS submittal, sequences and points list shall indicate routines that are controlled completely from the manufacturer's controllers, which routines are controlled partially by the manufacturer's controllers and BAS and which routines are controlled completely by the BAS.
   3. The BAS provider and equipment manufacturer, in collaboration, shall provide coordinated submittals tha indicate anything that has to be set, reset or accessed in a manufacturer's controller at the piece of equipment as opposed to being accessed at or from the BAS user interface/controller console. This coordination and collaboration shall occur at the submittal phase and well before equipment and controls are delivered to the site.

E. Unless otherwise noted, size all automatic control valves for maximum ten (10) feet water pressure drop at maximum design flow rate.

F. Refer to drawings for locations of all terminal units, room sensors, panels, dampers, valves, and equipment; where such devices are not indicated, however are required by the control sequences to achieve the intended operation, they shall be provided and located in the field where directed by the engineer.

G. Division 26 shall provide all detection devices (heat/smoke) as required by the contract documents. Division 23 shall install all detection devices including required control and power wiring required for mechanical systems. Detection devices shall provide automatic shutdown of the HVAC systems in accordance with the International Mechanical Code.

H. All pumps and fans shall be provided with a differential pressure sensor installed around the pump or fan. Sensor shall provide status indication for pump or fan operation. Current sensors with VA memory may be used instead of differential pressure sensors where indicated or noted.

I. Adjustable freezestats shall be provided at all preheat and heating coils and shall de-energize their respective air handling system when their setting of 35°F is reached. Freezestats for water

coils shall be installed in the coil leaving air stream. Freezestats shall be hard wired in the motor starter circuit and send an alarm signal to the BAS when they are activated.

J. All temperature, humidity, pressure, time, etc. set points shall be fully adjustable through the BAS. Final system setpoints will be confirmed through system commissioning and fixed prior to building occupancy. Thereafter setpoints shall be adjustable through the BAS by trained maintenance staff.

K. All two position dampers and valves shall be proven open by the use of end switches.

L. All control devices located within chemical storage areas shall be explosion proof suitably rated for each specific application.

M. Refer to individual input/output summary schedules for additional control devices not specifically described in the control narratives. Input/output summary schedules are minimum requirements; provide all required points for complete operation of the systems.

N. All variable frequency drives (VFD) for fans and pumps shall be soft started at minimum speed and increased to required operating speed by the BAS.

O. Each supply, return and exhaust fan shall be equipped with an inlet air monitoring device (AMD). The BAS shall continuously monitor the airflow rate for each fan. AMD's for exhaust fans shall be of a material suitable for the intended airstream.

P. Upon failure of any direct digital control (DDC) unit, an alarm shall be indicated on the BAS and the system shall automatically revert to the default cycle. All motors and fans shall remain in their last commanded state. When emergency power is available, the BAS shall monitor each essential power transfer switch and ramp the VFD's of selected fans and pumps to their lower limits until the emergency generator is stable and online; at which time the normal sequence of operations shall resume for selected fans and pumps.

Q. In general and unless otherwise noted, heating control valves shall fail open, specialist area heating control valves shall fail closed, steam control valves shall fail closed, chilled water control valves shall fail closed. Isolation dampers at fans and air units shall fail open.

R. Standby chillers, boilers, heat pumps, fans and pumps shall be alternated into operation every 500 hours. The BAS shall alarm for change over; actual change over shall be initiated by trained maintenance personnel through the BAS.

S. HVAC system controls shall not fail and lock out upon loss of power (such as under emergency conditions) and loss of power shall not be alarmed to the BAS.

T. Where used to control both comfort heating and cooling, zone thermostatic controls shall be capable of providing a temperature range or dead band of at least 5ºF within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum. Variable air volume (VAV) terminal units shall be programmed to operate at the minimum airflow setting without addition of reheat when the zone temperature is within the set dead band.

END OF SECTION 230900

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Copper tube and fittings.
2. Valves and specialties.
3. Refrigerants.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of valve, refrigerant piping, and piping specialty.

B. Shop Drawings:
1. Show piping size and piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
2. Show interface and spatial relationships between piping and equipment.
3. Shop Drawing Scale: 1/4 inch equals 1 foot.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.6 PRODUCT STORAGE AND HANDLING

A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-410A:
   1. Suction Lines for Air-Conditioning Applications: 300 psig.
   2. Suction Lines for Heat-Pump Applications: 535 psig.
   3. Hot-Gas and Liquid Lines: 535 psig.

2.2 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 88, Type K or L and ASTM B 280, Type ACR.

B. Wrought-Copper Fittings, Solder-Joint: ASME B16.22.

C. Wrought-Copper Fittings, Brazed-Joint: ASME B16.50.

D. Wrought-Copper Unions: ASME B16.22.

E. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

F. Brazing Filler Metals: AWS A5.8/A5.8M.

G. Flexible Connectors:
   1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
   2. End Connections: Socket ends.
   3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
   4. Working Pressure Rating: Factory test at minimum 500 psig.
   5. Maximum Operating Temperature: 250 deg F.

2.3 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Danfoss Inc.
      b. Heldon Products; Henry Technologies
      c. Parker Hannifin Corp.
      d. Paul Mueller Company
   2. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
   3. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
   4. Operator: Rising stem and hand wheel.
   5. Seat: Nylon.

6. End Connections: Socket, union, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 deg F.

B. Check Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. Danfoss Inc.
   c. Emerson Climate Technologies
   d. Heldon Products; Henry Technologies
   e. Parker Hannifin Corp.
   f. Paul Mueller Company
2. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
3. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
4. Piston: Removable polytetrafluoroethylene seat.
5. Closing Spring: Stainless steel.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 275 deg F.

C. Service Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Danfoss Inc.
   b. Emerson Climate Technologies
   c. Heldon Products; Henry Technologies
   d. Parker Hannifin Corp.
   e. Paul Mueller Company
   f. Refrigeration Sales, Inc.
2. Body: Forged brass with brass cap including key end to remove core.
3. Core: Removable ball-type check valve with stainless-steel spring.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Copper spring.
6. Working Pressure Rating: 500 psig.

D. Refrigerant Locking Caps:
1. Description: Locking-type, tamper-resistant, threaded caps to protect refrigerant charging ports from unauthorized refrigerant access and leakage.
2. Material: Brass, with protective shroud or sleeve.
3. Refrigerant Identification: Color-coded, refrigerant specific (for R-410A) or universal design (for all other refrigerants).
4. Special Tool: For installing and unlocking.

E. Straight-Type Strainers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Danfoss Inc.
   b. Heldon Products; Henry Technologies

c. Parker Hannifin Corp.
2. Body: Welded steel with corrosion-resistant coating.
3. Screen: 100-mesh stainless steel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig.
6. Maximum Operating Temperature: 275 deg F.

F. Moisture/Liquid Indicators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Danfoss Inc.
b. Emerson Climate Technologies
c. Heldon Products; Henry Technologies
d. Parker Hannifin Corp.
2. Body: Forged brass.
3. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
4. Indicator: Color coded to show moisture content in parts per million (ppm).
5. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
6. End Connections: Socket or flare.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 240 deg F.

G. Replaceable-Core Filter Dryers: Comply with AHRI 730.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Danfoss Inc.
b. Emerson Climate Technologies
c. Heldon Products; Henry Technologies
d. Parker Hannifin Corp.
2. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
3. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
4. Desiccant Media: Activated alumina or charcoal.
5. Designed for reverse flow (for heat-pump applications).
6. End Connections: Socket.
7. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
8. Maximum Pressure Loss: 2 psig.
9. Working Pressure Rating: 500 psig.
10. Maximum Operating Temperature: 240 deg F.

H. Liquid Accumulators: Comply with AHRI 495.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Emerson Climate Technologies
b. Heldon Products; Henry Technologies
c. Parker Hannifin Corp.
2. Body: Welded steel with corrosion-resistant coating.
3. End Connections: Socket or threaded.

4. Working Pressure Rating: 500 psig.
5. Maximum Operating Temperature: 275 deg F.

2.4 REFRIGERANTS

A. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 VALVE AND SPECIALTY APPLICATIONS

A. Install service valves for gauge taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

B. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

C. Except as otherwise indicated, install service valves on inlet and outlet side of filter dryers.

D. Install safety relief valves where required by 2010 ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

E. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

F. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.

G. Install flexible connectors at compressors.

H. Provide refrigerant locking caps on refrigerant charging ports that are located outdoors unless otherwise protected from unauthorized access by a means acceptable to the authority having jurisdiction.

3.2 INSTALLATION OF PIPING, GENERAL

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

L. Install refrigerant piping in protective conduit where installed belowground.

M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

N. Slope refrigerant piping as follows:
   1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
   2. Install horizontal suction lines with a uniform slope downward to compressor.
   3. Install traps and double risers to entrain oil in vertical runs.
   4. Liquid lines may be installed level.

O. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

P. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

Q. Identify refrigerant piping and valves.

R. Install sleeves for piping penetrations of walls, ceilings, and floors.

S. Install sleeve seals for piping penetrations of concrete walls and slabs.

T. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
   1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
   2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic restraints in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Comply with Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.

C. Install the following pipe attachments:
   1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
   2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
   3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
   4. Spring hangers to support vertical runs.
   5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

D. Install hangers for copper tubing, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Support horizontal piping within 12 inches of each fitting.

F. Support vertical runs of copper tubing to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Comply with ASME B31.5, Chapter VI.

2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.
    a. Fill system with nitrogen to the required test pressure.
    b. System shall maintain test pressure at the manifold gage throughout duration of test.
    c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
    d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

B. Prepare test and inspection reports.

3.6 SYSTEM CHARGING

A. Charge system using the following procedures:
1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.7 ADJUSTING

A. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

B. Adjust set-point temperature of controllers to the system design temperature.

C. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
1. Verify that compressor oil level is correct.
2. Open compressor suction and discharge valves.
3. Open refrigerant valves except bypass valves that are used for other purposes.
4. Check open compressor-motor alignment and verify lubrication for motors and bearings.

D. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

3.8 PIPING SCHEDULE

A. Suction Lines for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper (hard) tubing and wrought-copper fittings with brazed joints.

B. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, drawn-temper (hard) tubing and wrought-copper fittings with brazed joints.

C. Safety-Relief-Valve Discharge Piping, Copper: Copper, Type L, drawn-temper (hard) tubing and wrought-copper fittings with soldered joints.

END OF SECTION 232300

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Single-wall rectangular ducts and fittings.
2. Double-wall rectangular ducts and fittings.
3. Single-wall round and flat-oval ducts and fittings.
4. Double-wall round and flat-oval ducts and fittings.
5. Sheet metal materials.
6. Duct liner.
7. Sealants and gaskets.
8. Hangers and supports.
9. Seismic-restraint devices.

B. Related Sections:
1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233119 "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
3. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:
   1. Liners and adhesives.
   2. Sealants and gaskets.
   3. Seismic-restraint devices.

B. Shop Drawings:
   1. Factory- and shop-fabricated ducts and fittings.
   2. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
   3. Elevation of top and bottom of ducts.
   4. Dimensions of main duct runs from building grid lines.
   5. Fittings.
   6. Reinforcement and spacing.
   7. Seam and joint construction.
   8. Penetrations through fire-rated and other partitions.
   9. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
   10. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
   2. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 DUCT MATERIALS

A. Comply with requirements in "Duct Schedule" Article for applications of duct material, pressure class, duct seal-class level, and duct-leakage class.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eastern Sheet Metal, Inc.
2. McGill AirFlow LLC
3. MKT Metal Manufacturing
4. Set Duct Manufacturing
5. Sheet Metal Connectors, Inc.

B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-

support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
   1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
   2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
   3. Coat insulation with antimicrobial coating.

G. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
   1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

H. Inner Duct: Minimum 0.028-inch solid sheet steel.

I. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Traverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

J. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support

intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.5 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

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

1. Eastern Sheet Metal, Inc.
2. Linx Industries (formerly Lindab)
3. McGill AirFlow LLC
4. MKT Metal Manufacturing
5. SEMCO LLC
6. Set Duct Manufacturing
7. Sheet Metal Connectors, Inc.
8. Turnkey Duct Systems

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.

1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   a. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
   b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals,"

and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Inner Duct: Minimum 0.028-inch solid sheet steel.

E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
   1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
   2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
   3. Coat insulation with antimicrobial coating.

F. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
   1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at75 deg F mean temperature.

2.6 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G90.
   2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

D. 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.

E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
   1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.7 DUCT LINER

A. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Aeroflex USA, Inc.
      b. Armacell LLC
      c. Ductmate Industries, Inc
      d. Evonik Foams
      e. K-Flex USA
   2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
   3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

B. Insulation Pins and Washers:
   1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
   2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized steel or stainless steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
   1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
   2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
   3. Butt transverse joints without gaps, and coat joint with adhesive.
   4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
   5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
   6. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
   7. 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.
   8. 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.

2.8 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Water-Based Joint and Seam Sealant:
1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 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.

C. 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.

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.9 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive and Exterior Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.10 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. B-line, an Eaton business
2. Ductmate Industries, Inc
3. Hilti, Inc.
4. Kinetics Noise Control, Inc
5. Mason Industries, Inc.
6. Unistrut; Part of Atkore International
7. Vibration & Seismic Technologies, LLC

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of the ICC Evaluation Service, the Office of Statewide Health Planning and Development for the State of California or 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- or field-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 or ASTM A 492, stainless-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. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.

F. 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. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Sizes shown on plans are air side sizes. Where ducts are shown as lined, dimensions shall be increased to reflect that thickness of the lining.

D. Install ducts in maximum practical lengths.

E. Install ducts with fewest possible joints.

F. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

G. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

I. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

J. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

K. 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.

L. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

M. Protect duct from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines" for an advanced level of cleanliness.
   1. For work that does not comply with these requirements, at the Architect's or Owner representative's discretion the contractor shall:

a. Clean and restore all impacted air-moving and -distribution equipment to an advanced level of cleanliness in accordance with NADCA ACR 2013, Assessment, Cleaning & Restoration of HVAC Systems, including all items identified in the Standard as "recommended," "advised," and "suggested."
b. Verify cleanliness according to NADCA ACR 2013, "Verification of HVAC System Cleanliness" Section.

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.

B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings.

C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.4 DUCT SEALING

A. Ductwork and all plenums with pressure class ratings shall be constructed to Seal Class A, as required to meet the requirements of ASHRAE/IES 90.1.

B. Openings for rotating shafts shall be sealed with bushings or other devices that seal off air leakage.

C. All connections shall be sealed, including but not limited to spin-ins, taps, other branch connections, access doors, access panels, and duct connections to equipment.

D. Spiral lock seams need not be sealed.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Where practical, install concrete inserts before placing concrete.
   2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
   4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
   5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Concealed From View: Threaded rod and angle or channel supports.

E. Hangers Exposed to View:
   1. Rectangular: Threaded rod and angle or channel supports.
   2. Round or Oval: Steel cables.

F. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

G. 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.

3.6 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with ASCE/SEI 7.
   1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
   2. Brace a change 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. Install seismic-restraint devices using methods approved by an evaluation service member of the ICC Evaluation Service, the Office of Statewide Health Planning and Development for the State of California or an agency acceptable to authorities having jurisdiction.

F. 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.

G. 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, or grout has achieved full design strength.
   3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
   4. 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.

3.7 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.8 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner.
   1. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer.

B. Paint exterior of exposed metal ducts in occupied, conditioned spaces. Refer to Architectural reflected ceiling plan for areas where duct will be exposed.
   1. Exposed metal ducts shall be provided with grip finish.
   2. Apply one coat of latex paint (color by architect) over a compatible metal primer.

C. Paint materials and application requirements are specified in Division 09.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:
1. Leakage test procedures shall follow the outlines and classifications indicated in SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:
a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
b. Kitchen Exhaust Hood Ductwork: Test duct sections totaling no less than 100 percent of total installed duct area.
c. All vertical ductwork located within risers, chases and shafts shall be leak tested. The tests shall include each branch connection tap up to a point just beyond the shaft wall.
3. Each tested section shall incorporate at least: 5 transverse joints, typical seams, 2 elbows, one fire damper, one access door, 2 typical branch connections and 2 terminal unit connections.
4. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
5. Test for leaks before applying external insulation.
6. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
7. Give seven days' advance notice for testing. 3-5 days prior to each test, the contractor shall submit marked-up sheetmetal shop drawings of the duct section(s) to be tested, along with the allowable leakage calculations as required by SMACNA.
8. Additional tests of each pressure classification shall be required, at the owner's, Architect's or TAB contractors discretion, if subsequent ductwork installation becomes suspect and does not appear to maintain the same level of quality as the section tested.

C. Duct System Cleanliness Tests:
1. Visually inspect duct system to ensure that no visible contaminants are present.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.10 START UP

A. Air Balance: Comply with requirements in Section 230593 "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. Supply Air Ducts:
1. Ducts Connected to Multi-Zone Air-Handling Units, downstream, from air handling units to terminal units:
a. Concealed: Single wall, round, oval or rectangular as shown on drawings.

b. Exposed to View: Double wall, round, oval or rectangular as shown on drawings.
c. Pressure Class: Positive 6-inch wg.
d. SMACNA Seal Class: A.
e. SMACNA Leakage Class for Rectangular: 4.
f. SMACNA Leakage Class for Round and Flat Oval: 2.

2. Ducts Connected to Fan Coil Units, Heat Pumps, and Terminal Units, downstream, from unit to air device:
a. Concealed: Single wall, round, oval or rectangular as shown on drawings.
b. Exposed to View: Double wall, round, oval or rectangular as shown on drawings.
c. Pressure Class: Positive 2-inch wg.
d. SMACNA Seal Class: A.
e. SMACNA Leakage Class for Rectangular: 4.
f. SMACNA Leakage Class for Round and Flat Oval: 2.

C. Return Air and Transfer Ducts:
1. Ducts Connected to Air-Handling Units:
a. Single wall, round, oval or rectangular as shown on drawings.
b. Pressure Class: Positive or negative 2-inch wg.
c. SMACNA Seal Class: A.
d. SMACNA Leakage Class for Rectangular: 12.
e. SMACNA Leakage Class for Round and Flat Oval: 6.
2. Ducts Connected to Fan Coil Units, Heat Pumps, and Terminal Units:
a. Single wall, round, oval or rectangular as shown on drawings.
b. Pressure Class: Positive or negative 2-inch wg.
c. SMACNA Seal Class: A.
d. SMACNA Leakage Class for Rectangular: 4.
e. SMACNA Leakage Class for Round and Flat Oval: 2.
3. Transfer Ducts:
a. Single wall, round, oval or rectangular as shown on drawings.
b. Pressure Class: Positive or negative 2-inch wg.
c. SMACNA Seal Class: A.
d. SMACNA Leakage Class for Rectangular: 4.
e. SMACNA Leakage Class for Round and Flat Oval: 2.

D. Exhaust Air Ducts:
1. Ducts Connected to Fans Exhausting General and Toilet Air (ASHRAE 62.1, Class 1 and 2):
a. Single wall, round, oval or rectangular as shown on drawings.
b. Pressure Class: Negative 2-inch wg.
c. SMACNA Seal Class: A.
d. SMACNA Leakage Class for Rectangular: 4.
e. SMACNA Leakage Class for Round and Flat Oval: 2.
2. Ducts Connected to Commercial Kitchen Hoods: Comply with IMC.
a. Single wall, round, oval or rectangular as shown on drawings.
b. Material: Type 304, stainless-steel sheet.
1) Exposed to View: No. 4 finish.
2) Concealed: No. 2D finish.
c. Pressure Class: Negative 3-inch wg.
d. Welded seams, joints, and penetrations.
e. Airtight/Watertight.

E. Intermediate Reinforcement:
1. Galvanized-Steel Ducts: Galvanized steel.
2. Stainless-Steel Ducts: Stainless steel.
3. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.

F. Liner:
1. Transfer Ducts: Flexible elastomeric, 1 inch thick.

G. Double-Wall Duct Interstitial Insulation:
1. Supply Air Ducts: Flexible elastomeric, 2 inches thick.

H. Elbow Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
    a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
    c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
    a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
        1) Radius-to Diameter Ratio: 1.5.
    b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
    c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

I. Branch Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
    a. Rectangular Main to Rectangular Branch: 45-degree entry.
    b. Rectangular Main to Round Branch: Spin in.
        1) In no case should the round branch plus associated flange be larger than the height of rectangular main. Where the condition exists, provide a rectangular main to rectangular branch with 45-degree entry, and transition to round duct.
2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
    a. Velocity 1000 fpm or Lower: 90-degree tap.
    b. Velocity 1000 to 1500 fpm: Conical tap.
    c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Automatic balancing dampers.
4. Control dampers.
5. Fire dampers.
6. Smoke dampers.
7. Combination fire and smoke dampers.
8. Flange connectors.
9. Duct silencers.
10. Air transfer silencers
11. Duct lagging
12. Remote damper operators.
13. Duct-mounted access doors.
14. Flexible connectors.
15. Flexible ducts.
16. Duct accessory hardware.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

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.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G90.
   2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and No. 4 finish for exposed ducts.

C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Air Balance Inc.; a division of Mestek, Inc.
   2. American Warming and Ventilating; a division of Mestek, Inc.
   3. Flexmaster U.S.A., Inc.
   4. McGill AirFlow LLC.
   5. Nailor Industries Inc.
   6. NCA Manufacturing, Inc; a division of Metal Industries Inc.
   7. Pottorff.
   8. Ruskin Company.
   9. Tamco; T. A. Morrison & Co., Inc.
   10. Trox USA Inc.
   11. United Enertech
   12. Vent Products Company, Inc.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 2500 fpm.

D. Maximum System Pressure: 2-inch wg.

E. Frame: Hat-shaped, 0.090-inch- thick extruded aluminum, with welded corners or mechanically attached and mounting flange.

F. Blades: Multiple single-piece blades, end pivoted, maximum 6-inch width, 0.050-inch- thick extruded aluminum with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Extruded vinyl, mechanically locked.

I. Blade Axles:
1. Material: Aluminum.
2. Diameter: 0.20 inch.

J. Tie Bars and Brackets: Aluminum.

K. Return Spring: Adjustable tension.

L. Bearings: Synthetic pivot bushings.

M. Accessories:
1. Adjustment device to permit setting for varying differential static pressure.
2. Screen Mounting: Rear mounted.
3. Screen Material: Aluminum.
4. Screen Type: Insect.
5. 90-degree stops.

2.4 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Warming and Ventilating; a Mestek Architectural Group company
   b. McGill AirFlow LLC
   c. Nailor Industries Inc
   d. NCA Manufacturing, Inc; a division of Metal Industries Inc.
   e. Pottorff
   f. Ruskin Company
   g. Trox USA Inc.
   h. United Enertech
   i. Vent Products Co., Inc
2. Performance:
   a. Leakage Rating Class III: Leakage not exceeding 40 cfm/sq. ft. against 1-inch wg differential static pressure
3. Construction:

a. Linkage outside of airstream.
b. Suitable for horizontal or vertical applications.

4. Frames:
   a. Hat-shaped, 16-gauge- thick, galvanized sheet steel.
   b. Mitered and welded corners.
   c. Flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized-steel, 16 gauge thick.
6. Blade Axles: Galvanized steel, hex.
7. Bearings:
   a. Molded synthetic.
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Tie Bars and Brackets: Galvanized steel.
9. Locking device to hold damper blades in a fixed position without vibration.

2.5 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Arrow United Industries
   2. Cesco Products; a division of MESTEK, Inc.
   3. Greenheck Fan Corporation
   4. McGill AirFlow LLC
   5. Nailor Industries Inc
   6. NCA Manufacturing, Inc; a division of Metal Industries Inc.
   7. Pottorff
   8. Ruskin Company
   9. Tamco; T. A. Morrison & Co., Inc.
   10. United Enertech

B. Low-leakage rating with linkage outside airstream and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Frames:
   1. Hat shaped.
   2. 16 gauge, galvanized sheet steel. Provide Type 304, stainless steel for installation in stainless steel ductwork and corrosive atmospheres.
   3. Mitered and welded corners.

D. Blades:
   1. Multiple airfoil-shaped with maximum blade width of 6 inches.
   2. Parallel- and opposed-blade design.
      a. Opposed blade design for modulating applications.
      b. Parallel blade design for two-position applications.

3. Galvanized-steel. Provide Type 304, stainless steel for installation in stainless steel ductwork and corrosive atmospheres.
4. 0.064 inch thick single skin.
5. Blade Edging: Closed-cell neoprene.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

E. Blade Axles: 1/2-inch- diameter; galvanized steel hex-shaped; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
1. Operating Temperature Range: From minus 40 to plus 200 deg F.

F. Bearings:
1. Self-lubricating stainless-steel sleeve.
2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

2.6 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Arrow United Industries
2. Cesco Products; a division of MESTEK, Inc.
3. Greenheck Fan Corporation
4. Nailor Industries Inc
5. NCA Manufacturing, Inc; a division of Metal Industries Inc.
6. Pottorff
7. Ruskin Company
8. United Enertech

B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.

D. Fire Rating: 1-1/2 hours. 3-hour dampers shall be installed where required by wall or floor rating.

E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
1. Minimum Thickness: 20 gauge thick, as indicated, and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 24 gauge thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

2.7 SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cesco Products; a division of MESTEK, Inc.
2. Greenheck Fan Corporation
3. Nailor Industries Inc
4. NCA Manufacturing, Inc; a division of Metal Industries Inc.
5. Pottorff
6. Ruskin Company
7. United Enertech

B. General Requirements: Label according to UL 555S by an NRTL.

C. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel, with welded or mechanically attached corners and mounting flange.

D. Blades: Roll-formed, horizontal, airfoil-shaped, single piece, double skin, 14 gauge, galvanized sheet steel.

E. Leakage: Class I.

F. Rated pressure and velocity to exceed design airflow conditions.

G. Mounting Sleeve: Factory-installed, 0.039-inch- thick, galvanized sheet steel; length to suit wall or floor application.

H. Damper Motors: Modulating or two-position action, as required.

I. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
3. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
4. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
5. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.

6. Electrical Connection: 115 V, single phase, 60 Hz.

J. Accessories:
1. Auxiliary switches for position indication.
2. Test and reset switches: Damper mounted if easily accessible, otherwise remote mounted.

2.8 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cesco Products; a division of MESTEK, Inc.
2. Greenheck Fan Corporation
3. Nailor Industries Inc
4. NCA Manufacturing, Inc; a division of Metal Industries Inc.
5. Pottorff
6. Ruskin Company
7. United Enertech

B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.

D. Fire Rating: 1-1/2 hours. 3-hour dampers shall be installed where required by wall or floor rating.

E. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel, with welded or mechanically attached corners and mounting flange.

F. Heat-Responsive Device: Electric resettable device and switch package, factory installed, rated.

G. Blades: Roll-formed, horizontal, true airfoil-shaped, single piece, double skin, 14 gauge, galvanized sheet steel.

H. Leakage: Class I.

I. Rated pressure and velocity to exceed design airflow conditions.

J. Mounting Sleeve: Factory-installed, 0.039-inch- thick, galvanized sheet steel; length to suit wall or floor application.

K. Master control panel for use in dynamic smoke-management systems.

L. Damper Motors: Modulating or two-position action, as required.

M. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
7. Electrical Connection: 115 V, single phase, 60 Hz.

N. Accessories:
1. Auxiliary switches for position indication.
2. Test and reset switches: Damper mounted if easily accessible, otherwise remote mounted.

2.9 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc
2. Hardcast, Inc.
3. Nexus PDQ
4. Ward Industries; a brand of Hart & Cooley, Inc

B. Description: Factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.10 AIR TRANSFER SILENCERS

A. Return Air Canopy
1. Basis-of-Design Product: Subject to compliance with requirements, provide Price RAC or comparable product by one of the following:
a. Commercial Acoustics
b. Dynasonics
c. Flex-Tek Group
d. Industrial Noise Control, Inc
e. McGill AirFlow LLC
f. Price
g. Ruskin Company
2. General:

a. Furnish and install return air canopy air transfer silencers of the size, configuration, and acoustic performance as described on the plans and schedules.

3. Performance:
   a. Return air canopy performance characteristics, including insertion loss and pressure drop, shall be attained through testing in accordance with ASTM Standard E477.
   b. Laboratory performance verification in the manufacturer's test facility may be requested, in which case a comparative test report shall be made available to the engineer.
4. Construction:
   a. Return air canopies shall be constructed in accordance with ASHRAE and SMACNA Standards for the pressure and velocity classification specified for the air distribution system in which it is installed.
   b. Return air canopies shall be constructed of:
      1) 24 gauge solid steel casing
      2) Acoustic media:
         a) Fiber free foam liner.
   c. Acoustic media:
      1) Fiber free foam:
         a) Fiber free foam shall be self-sealing engineered foam that will not expose fibers to the airstream.
         b) Fiber free foam shall be in accordance with erosion requirements of UL 181, and shall conform to the physical properties and requirements of ASTM C1071.
         c) Mold growth and humidity requirements shall be in accordance with ASHRAE Standard 62.1.
   d. Fire-Performance Characteristics:
      1) Air transfer silencer assemblies, including acoustic media fill, sealants, and acoustical spacers shall have combustion rating equal to or less than shown below when tested according to ASTM E84, NFPA 255 or UL 723:
         a) Flame-spread index not exceeding 25
         b) Smoke-developed index not exceeding 50

B. Cross Talk Air Transfer Silencer (Transfer Duct)
1. Basis-of-Design Product: Subject to compliance with requirements, provide Price XTU or comparable product by one of the following:
   a. Commercial Acoustics
   b. Dynasonics
   c. Flex-Tek Group
   d. Industrial Noise Control, Inc
   e. McGill AirFlow LLC
   f. Price
   g. Ruskin Company
2. Furnish and install cross talk air transfer silencers of the size, configuration, and acoustic performance as described on the plans and schedules.
3. Performance:
   a. Cross Talk Silencer performance characteristics, including insertion loss and pressure drop, shall be attained through testing in accordance with ASTM Standard E477.

b. Laboratory performance verification in the manufacturer's test facility may be requested, in which case a comparative test report shall be made available to the engineer.

4. Construction:
   a. Cross talk silencers shall be constructed in accordance with ASHRAE and SMACNA Standards for the pressure and velocity classification specified for the air distribution system in which it is installed.
   b. Cross talk silencers shall be constructed of:
      1) 22-gauge solid steel casing
      2) 26-gauge solid steel internal noses at inlet and outlet
      3) ¾ inch dual density absorptive fiberglass media.
   c. Cross talk silencers shall be fastened with the use of button lock, Pittsburgh lock, and welds. Screws and other types of mechanical fasteners shall not be acceptable.
   d. Acoustic media:
      1) Acoustic media shall be shot-free inorganic glass fiber with long, resilient fibers, bonded with thermosetting resin.
      2) Glass fiber shall be in accordance with erosion requirements of UL 181, and shall conform to the physical properties and requirements of ASTM C1071.
   e. Fire-Performance Characteristics:
      1) Cross talk silencer assemblies, including acoustic media fill, sealants, and acoustical spacers shall have combustion rating equal to or less than shown below when tested according to ASTM E84, NFPA 255 or UL 723:Air Transfer Silencers-3v001
         a) Flame-spread index not exceeding 25
         b) Smoke-developed index not exceeding 50

C. Return Air Silencer
1. Basis-of-Design Product: Subject to compliance with requirements, provide Price RAS-LP-T or comparable product by one of the following:
   a. Commercial Acoustics
   b. Dynasonics
   c. Flex-Tek Group
   d. Industrial Noise Control, Inc
   e. McGill AirFlow LLC
   f. Price
   g. Ruskin Company
2. General:
   a. Furnish and install return air silencer air transfer silencers of the size, configuration, air volume, and air flow direction as described on the plans and schedules.
3. Performance:
   a. Silencer performance characteristics, including insertion loss and pressure drop, shall be attained through testing in accordance with ASTM Standard E477.
   b. Laboratory performance verification in the manufacturer's test facility may be requested, in which case a comparative test report shall be made available to the engineer.
4. Construction:
   a. Air transfer silencers shall be constructed in accordance with ASHRAE and SMACNA Standards for the pressure and velocity classification specified for the air distribution system in which it is installed.
   b. Air transfer silencers shall be constructed of:

1) 24-gauge solid galvanized steel casing
2) 24-gauge perforated galvanized steel liner.
3) Absorptive acoustic fiberglass.

c. Acoustic media:
1) Acoustic media shall be shot-free inorganic glass fiber with long, resilient fibers, bonded with thermosetting resin.
2) Glass fiber shall be packed with a minimum of 10% compression to eliminate voids and settling.
3) Acoustic media shall be lined with a layer of polymer film securely wrapped around the internal acoustic media to prevent contamination from moisture and airborne particulate that may be present in the airstream.

d. Fire-Performance Characteristics:
1) Air transfer silencer assemblies, including acoustic media fill, sealants, and acoustical spacers shall have combustion rating equal to or less than shown below when tested according to ASTM E84, NFPA 255 or UL 723:
a) Flame-spread index not exceeding 25
b) Smoke-developed index not exceeding 50

2.11 DUCT LAGGING

A. Basis-of-Design Product: Subject to compliance with requirements, provide Kinetics Noise Control, Inc. KNM-100AL or comparable product by one of the following:
1. Acoustical Surfaces, Inc.
2. eNoise Control
3. Kintetics Noise Control, Inc
4. IES2000
5. Sound Seal

B. The barrier shall be constructed of a minimum 0.10" thick mass loaded, limp vinyl sheet bonded to a thin layer of reinforced aluminum foil on one side.

C. The barrier shall have a minimum nominal density of 1.0-psf.

D. Sound Transmission Loss (dB) when tested as a free hanging barrier:
1. 125 Hz: 13
2. 250 Hz: 17
3. 500 Hz: 21
4. 1000 Hz: 28
5. 2000 Hz: 33
6. 4000 Hz: 40

E. Surface Burning characteristics per ASTM E84: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.12 REMOTE DAMPER OPERATORS

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

1. Pottorff
2. Ventfabrics, Inc
3. Young Regulator Company

B. Description: Cable system designed for remote manual damper adjustment.

C. Cable: Steel.

D. Wall-Box Mounting: Recessed or surface, as called for on the drawings.

E. Wall-Box Cover-Plate Material: Steel.

2.13 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cesco Products; a division of MESTEK, Inc.
2. Ductmate Industries, Inc
3. Flexmaster U.S.A., Inc
4. Greenheck Fan Corporation
5. McGill AirFlow LLC
6. Nailor Industries Inc
7. NCA Manufacturing, Inc; a division of Metal Industries Inc
8. Pottorff
9. Ruskin Company
10. United Enertech
11. Ventfabrics, Inc
12. Ward Industries; a brand of Hart & Cooley, Inc

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
1. Door:
   a. Double wall, rectangular.
   b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
   c. Vision panel.
   d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
   e. Fabricate doors airtight and suitable for duct pressure class.
2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:
   a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
   b. Access Doors up to 18 Inches Square: Continuous and two sash locks.
   c. Access Doors up to 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.
   d. Access Doors Larger Than 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.

C. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.
2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Factory set at 3.0- to 8.0-inch wg.
5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.14 DUCT ACCESS PANEL ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. 3M
   2. Ductmate Industries, Inc
   3. Flame Gard, Inc
   4. Ruskin Company

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0428-inch stainless steel.

D. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.15 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ductmate Industries, Inc
   2. Duro Dyne Inc.
   3. Hardcast, Inc.
   4. Ventfabrics, Inc
   5. Ward Industries; a brand of Hart & Cooley, Inc

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
1. Minimum Weight: 24 oz./sq. yd..
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

G. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
1. Minimum Weight: 16 oz./sq. yd..
2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F.

H. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
1. Minimum Weight: 14 oz./sq. yd..
2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F.

I. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.16 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Castco – Model SF-181M.
2. Thermaflex – Model MKE
3. JPL – Model AMR.

B. Insulated, Acoustical Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
   1. Pressure Rating: 6-inch wg positive and 1.0-inch wg negative.
   2. Maximum Air Velocity: 4000 fpm.
   3. Temperature Range: Minus 20 to plus 175 deg F.
   4. Insulation R-Value: Comply with ASHRAE/IESNA 90.1.

C. Flexible Duct Connectors:
   1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.
   2. Non-Clamp Connectors: Liquid adhesive plus sheet metal screws and tape.

D. Flexible Duct Elbow Supports:
   1. Universal-mount, 1-piece, fully adjustable, radius-forming brace to support 4-inch through 16-inch diameter flexible air ducts.
   2. Classified: UL 2043.
   3. Material: 100 percent recycled copolymer polypropylene.
   4. Support Frame Radius: 8 inches.
   5. Compliance for Flexible Duct Radius:
      a. SMACNA HVAC Duct Construction Standards.
      b. ASHRAE Advanced Energy Design Guides.
      c. ADC Flexible Duct Performance and Installation Standards.

2.17 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install control dampers in exhaust ductwork:
   1. For rooftop and base mounted fans, install damper at inlet of exhaust fans or in the exhaust duct close to exhaust fan unless otherwise indicated.

2. For in-line exhaust fans, install damper in exhaust duct downstream of fan as close as possible to exhaust plenum/louver unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.
3. Install stainless steel volume dampers in stainless steel ducts.

E. 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.

F. Mark the locations of all above-ceiling duct mounted dampers with orange non-adhesive surveyors flagging tape.

G. Set dampers to fully open position before testing, adjusting, and balancing.

H. Install test holes at fan inlets and outlets and elsewhere as indicated.

I. Install fire and smoke dampers according to UL listing.

J. Duct Smoke Detectors:
1. HVAC duct smoke detectors shall be furnished as specified elsewhere by Division 28 for installation under Division 23. All wiring for air duct detectors shall be provided under Division 28.
2. Comply with NFPA 72 and IMC. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.
3. Verify proper length and orientation on the sampling tube. Confirm the sampling tube protrudes into the duct in accordance with system design and per manufacturer's instructions.
4. Verify the smoke detector is rigidly mounted. Confirm that no penetrations in a return air duct exist in the vicinity of the detector. Confirm the detector is installed so as to sample the airstream at the proper location in the duct.
5. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.
6. Where duct detectors are used to initiate the operation of smoke dampers, they should be located so that the detector is between the last inlet or outlet upstream of the damper and the first inlet or outlet downstream of the damper.

K. Connect ducts to duct silencers rigidly.

L. Duct Lagging:
1. Install acoustical pipe and duct lagging in locations indicated. Comply with manufacturers written instructions for installation by using type of mounting accessories indicated or, if not indicated, as recommended by the manufacturer.
2. Duct shall be wrapped with specified insulation prior to application of the duct lagging.
3. Duct lagging material shall be cut to length, wrapped around the outside of the duct, and fastened with mechanical fasteners, bands or manufacturer's foil lag tape.

4. Duct sound control lagging materials must be installed per the manufacturer's installation guidelines.

M. Fire and Smoke Damper Access and Identification
1. Fire and smoke dampers shall be provided with an approved means of access, large enough to permit inspection and maintenance of the damper and its operating parts.
2. The access shall not affect the integrity of fire-resistance-rated assemblies.
3. Access points shall be permanently identified on the exterior by a label having letters not less than 0.5 inch in height reading: FIRE/SMOKE DAMPER, SMOKE DAMPER or FIRE DAMPER.
4. Access doors in ducts shall be tight fitting and suitable for the required duct construction.

N. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
1. On both sides of duct coils.
2. Upstream and downstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from control dampers, backdraft dampers, and equipment.
6. Control devices requiring inspection.
7. Elsewhere as indicated.

O. Install access doors with swing against duct static pressure.

P. Access Door Sizes:
1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

Q. Label access doors.

R. Install flexible connectors to connect ducts to equipment.

S. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

T. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

U. Connect diffusers to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.

V. Connect flexible ducts to metal ducts with draw bands or adhesive plus sheet metal screws.

W. Make bends in flexible ducts with minimum of 1-duct diameter centerline radius.

X. Where flexible ductwork is used as an elbow, provide flexible, durable duct elbow supports over outer jacket of flexible ducts to form smooth, 90-degree bends to eliminate flexible duct kinks and airflow restrictions.

Y. Install duct test holes where required for testing and balancing purposes.

Z. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.
6. Test duct smoke detectors per NFPA 72. Detectors that use sampling tubes shall be tested to ensure that they will properly sample the airstream in the duct using a method acceptable to the manufacturer or in accordance with their published instructions. Preferred method is to use a manometer to measure the differential pressure between the two sampling tubes. Verifying the differential pressure is within the manufacturer documented acceptable levels.
7. Test all new fire, smoke and combination fire/smoke dampers both at project completion as well as at the end of the one-year warranty period. Contractor shall provide the test results for both tests on the standard damper testing form.

END OF SECTION 233300

SECTION 233416 - HVAC FANS

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: For each product.

1. HVAC fans.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Include rated capacities, furnished specialties, and accessories for each fan.
2. Certified fan performance curves with system operating conditions indicated.
3. Certified fan sound-power ratings.
4. Motor ratings and electrical characteristics, plus motor and electrical accessories.
5. Material thickness and finishes, including color charts.
6. Dampers, including housings, linkages, and operators.
7. Fan speed controllers.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
5. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For centrifugal fans to include in emergency, operation, and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Belts: One set(s) for each belt-driven unit.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AMCA Compliance:
1. Comply with AMCA performance requirements and bear the AMCA-Certified Ratings Seal.
2. Operating Limits: Classify according to AMCA 99.

B. Balance Quality:
1. All wheels (rotors/impellers) shall be factory statically and dynamically balanced on precision electronic balancers to a Balance Quality Grade G6.3 per ANSI/AMCA Standard 204-05 or better.

C. Vibration Levels:
1. Each fan assembly shall be vibration tested before shipping in accordance with AMCA 204-05.
2. Each assembled fan shall be test run at the factory at the specified fan RPM and vibration signatures shall be taken on each bearing in three planes - horizontal, vertical, and axial.
3. Unless otherwise indicated, the maximum allowable factory fan vibration shall be less than 0.15 in./sec peak velocity for rigidly mounted fans and 0.20 in./sec peak velocity for flexibly mounted fans. Values are peak velocity values, filter-in, at the fan rotational speed.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Capacities and Characteristics: Refer to drawings.

2.2 CENTRIFUGAL UPBLAST ROOF EXHAUSTER, DIRECT DRIVE (TYPE A)

A. Basis-of-Design Product: Subject to compliance with requirements, provide Greenheck CUE or comparable product by one of the following:
1. American Coolair Corporation
2. Greenheck Fan Corporation
3. Loren Cook Company
4. New York Blower Company (The)
5. Twin City Fan & Blower

B. Description:
1. Factory-fabricated, -assembled, -tested, and -finished, direct-driven centrifugal upblast roof exhauster, configured for vertical flow, consisting of wheel, motor, drive assembly, and support structure.

2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.

C. Housing: Heavy gauge spun aluminum construction of shroud, top cover, and motor bands. Roll edge beads.

1. Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.
2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

E. Finish: Galvanized mill finish internal parts, and uncoated external aluminum parts exposed to weather.

F. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Disconnect Switch: Nonfusible type, NEMA 4 with thermal-overload protection. Factory mount and wire through an internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch mesh, aluminum wire.
4. Motorized Damper: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan is not energized.
   a. Fabricate frame from galvanized steel.
   b. Fabricate blades from aluminum, mill finish, with vinyl edge seals.
   c. Damper actuator suitable for 24 VAC, single phase.
5. Pressure Probe: ¼ inch diameter in the fan venturi that allows hook-up to manometer.

G. Curb Cap: One-piece, weather-tight aluminum construction, pre-punched mounting holes for attachment to roof curb. Include flange to mate with fan unit inlet flange.
1. Provide electrical metal tubing (EMT) conduit into motor compartment, with watertight fitting at curb cap penetration.
2. Provide foam curb seal.

H. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
1. Configuration: Built-in cant and mounting flange.
2. Overall Height: 12 inches.
3. Pitch Mounting: Manufacture curb for roof slope, when required for level installation.

2.3 CENTRIFUGAL KITCHEN UPBLAST ROOF EXHAUSTER, DIRECT DRIVE (TYPE M)

A. Basis-of-Design Product: Subject to compliance with requirements, provide Captive Aire or comparable product by one of the following:
1. American Coolair Corporation
2. Greenheck Fan Corporation
3. Loren Cook Company

4. New York Blower Company (The)
5. Twin City Fan & Blower

B. Description:
1. Factory-fabricated, -assembled, -tested, and -finished, direct-driven centrifugal upblast roof exhauster, configured for vertical flow of grease and moisture laden exhaust air, consisting of wheel, motor, drive assembly, and support structure.
2. Listed in accordance with UL/cUL 762 for grease-laden air.
3. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.

C. Housing: Heavy gauge spun aluminum construction of shroud, top cover, and motor bands. Roll edge beads.

1. Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.
2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

E. Finish: Galvanized mill finish internal parts, and uncoated external aluminum parts exposed to weather.

F. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Disconnect Switch: Nonfusible type, NEMA 4 with thermal-overload protection. Factory mount and wire through an internal aluminum conduit.
3. High-Temperature Firestat: To de-energize single phase motor: Manual reset type, field adjustable from 100 - 170 deg F
4. Bird Screens: Removable, 1/2-inch mesh, aluminum wire.
5. Drain Trough: Allows for one-point drainage of water, grease, and other residues
6. Grease Trap:
   a. Constructed of aluminum
   b. Includes drain connection
   c. Collects grease residue
7. Pressure Probe: ¼ inch diameter in the fan venturi that allows hook-up to manometer.

G. Curb Cap: One-piece, weather-tight aluminum construction, pre-punched mounting holes for attachment to roof curb. Include flange to mate with fan unit inlet flange.
1. Provide electrical metal tubing (EMT) conduit into motor compartment, with watertight fitting at curb cap penetration.
2. Provide foam curb seal.

H. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
1. Configuration: Built-in cant and mounting flange.
2. Overall Height: 12 inches.

3. Pitch Mounting: Manufacture curb for roof slope, when required for level installation.

2.4 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.5 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210/ASHRAE 51, "Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fans level and plumb.

B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

D. Equipment Mounting:
1. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

E. Curb Support: Install roof curb on roof structure, level and secure, according to "The NRCA Roofing and Waterproofing Manual," Low-Slope Membrane Roofing Construction Details Section, Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install and secure fans on curbs, and coordinate roof penetrations and flashing with roof construction. Secure units to curb support.

F. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Section 230548 "Vibration and Seismic Controls for HVAC."

G. Install units with clearances for service and maintenance.

H. Label fans according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

B. Install ducts adjacent to fans to allow service and maintenance.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete.
3. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
4. Verify that cleaning and adjusting are complete.
5. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
6. Trim balance assembled fans to reduce vibration to acceptable operation in-situ START-UP vibration levels in accordance with AMCA Standard 204-05. The final assembly test run shall be provided BEFORE commissioning for service.
7. Adjust belt tension.
8. Adjust damper linkages for proper damper operation.
9. Verify lubrication for bearings and other moving parts.
10. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
11. See Section 230593 "Testing, Adjusting, and Balancing For HVAC" for testing, adjusting, and balancing procedures.
12. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION 233416

SECTION 233600 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Shutoff, single-duct supply air terminal units.
2. Parallel, fan-powered air terminal units.
3. Shutoff, single-duct exhaust air terminal units.
4. Casing liner.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of air terminal unit.
1. Include construction details, material descriptions, dimensions of individual components and profiles, mounting details and finishes for air terminal units.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, and location of each field connection (right or left).
4. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air terminal units 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 resetting minimum and maximum air volumes.
b. Instructions for adjusting software set points.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fan-Powered-Unit Filters: Furnish one spare filter(s) for each filter installed.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of terminal units that fail in materials or workmanship within specified warranty period.
   1. One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

C. ASHRAE Compliance: Applicable requirements in ASHRAE/IES 90.1, "Section 6 - Heating, Ventilating, and Air Conditioning."

2.2 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Anemostat Products; a Mestek company
   2. Carnes Company
   3. Carrier Corporation; a unit of United Technologies Corp.
   4. ENVIRO-TEC; by Johnson Controls, Inc
   5. Johnson Controls
   6. Krueger
   7. METALAIRE, Inc
   8. Nailor Industries Inc
   9. Price Industries
   10. Titus
   11. Trane
   12. Tuttle & Bailey

B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.

C. Casing: 22 gauge (0.034-inch) galvanized steel, single wall.
   1. Casing Liner: Comply with requirements in "Casing Liner" Article for flexible elastomeric duct liner.
   2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
   3. Air Outlet: S-slip and drive connections for duct attachment.
   4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.

5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Volume Damper: 16 gauge (0.064-inch) thick galvanized steel with peripheral gasket and self-lubricating bearings.
   1. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
   2. Damper Position: Normally open.

E. Attenuator Section: 22 gauge (0.034-inch) steel sheet.
   1. Attenuator Section Liner: Comply with requirements in "Casing Liner" Article for flexible elastomeric duct liner.
   2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

F. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.
   1. SCR controlled.
   2. Access door interlocked disconnect switch.
   3. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable).
   4. Nickel chrome 80/20 heating elements.
   5. Airflow switch for proof of airflow.
   6. Fan interlock contacts.
   7. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
   8. Mercury contactors.
   9. Pneumatic-electric switches and relays.

G. Direct Digital Controls: Control devices shall be compatible with temperature controls system specified in Section 230900 "Building Automation and Temperature Controls."
   1. Factory installed controls furnished under Division 23, Section "Building Automation and Temperature Controls".
   2. The terminals shall be equipped with pressure independent controls which can be reset to modulate airflow between zero and the maximum cataloged cubic feet per minute. Maximum airflow limiters are not acceptable.
   3. The direct digital controls shall be supplied by the control contractor and mounted by the terminal unit manufacturer. Control contractor shall provide data sheets on all components to be mounted, indicating component dimensions, mounting hardware, and methods, as well as wiring and piping diagrams for each application identified by unit tag per the schedule in the drawings, to the terminal manufacturer.
   4. Controls shall be compatible with pneumatic inlet velocity sensors supplied by the terminal manufacturer. The sensor shall be multi-point center averaging type, with a minimum of four measuring ports parallel to the take-off point from the sensor. Sensors with measuring ports in series are not acceptable. The sensor must provide a minimum differential pressure signal of 0.03 inch wg. at an inlet velocity of 500 fpm. The sensor must provide control signal accuracy of plus or minus five (5) percent with the same size inlet duct at any inlet condition.

5. Controls shall be field set by control contractor for the scheduled minimum and maximum flow rates. Flow measuring taps and flow curves will be supplied with each terminal for field balancing airflow. All pneumatic tubing shall be UL listed fire retardant (FR) type. Each terminal shall be equipped with labeling showing unit location, size, minimum and maximum cubic feet per minute setpoints, damper fail position, and thermostat action.
6. The terminal manufacturer shall provide a Class II 24 VAC transformer and disconnect switch. Actuator shall be direct connection shaft mount type without linkage. All controls shall be installed in approved NEMA type sheet metal enclosure by terminal manufacturer.

7. Box controllers with self calibration shall not interrupt flow.

2.3 CASING LINER

A. Casing Liner: Flexible elastomeric duct liner fabricated of preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
   1. Minimum Thickness: 3/4 inch.
   2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
   3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

2.4 SOURCE QUALITY CONTROL

1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and AHRI certification seal.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 5, "Hangers and Supports" and with Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Where practical, install concrete inserts before placing concrete.
   2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches thick.
   4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.
   5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.2 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install hangers and braces designed to support the air terminal units and to restrain against seismic forces required by applicable building codes. Comply with ASCE/SEI 7. Comply with requirements for seismic-restraint devices in Section 230548 "Vibration and Seismic Controls for HVAC."

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 air terminal units 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 before drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify 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, or 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.

3.3 TERMINAL UNIT INSTALLATION

A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

C. Unless otherwise indicated, air terminal units and associated controls shall be installed at a height no greater than 3 feet above a ceiling to allow maintenance accessibility.

3.4 CONNECTIONS

A. Where installing piping adjacent to air terminal unit, allow space for service and maintenance.

B. Hot-Water Piping: Connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.

C. Comply with requirements in Section 233113 "Metal Ducts" for connecting ducts to air terminal units.

D. Make connections to air terminal units with flexible connectors complying with requirements in Section 233300 "Air Duct Accessories."

3.5 IDENTIFICATION

A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
   2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Air terminal unit will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.7 STARTUP SERVICE

A. Perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
   3. Verify that controls and control enclosure are accessible.
   4. Verify that control connections are complete.
   5. Verify that nameplate and identification tag are visible.
   6. Verify that controls respond to inputs as specified.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 233600

SECTION 233713 - AIR 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. Registers, grilles and diffusers.

B. Related Requirements:

1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples for Initial Selection: For diffusers with factory-applied color finishes.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

PART 2 - PRODUCTS

2.1 AIR DEVICES, GENERAL

A. Basis-of-Design Product: Subject to compliance with requirements, provide Titus or comparable product by one of the following:
1. Anemostat Products; a Mestek company
2. Carnes Company
3. Krueger
4. METALAIRE, Inc
5. Nailor Industries Inc
6. Price Industries
7. Titus
8. Tuttle & Bailey

B. Provide air devices of the minimum sizes and quantities indicated and of the types specified.

C. Contractor shall carefully study the drawings and the field conditions to ascertain the air device requirements as to suitability, location, air capacity, required accessories, border and finish.

D. Border types shall be compatible with Architectural ceiling type for the room for which the air device is located. All devices shall have plaster frames when installed in plaster or drywall construction.

E. Margins shall be as indicated or directed to suit field conditions.

F. Verification of Performance: Rate diffusers according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

G. Air devices shall be selected to provide draft-free air distribution over entire area served and sound rating shall not exceed Noise Criteria (NC) 25.

H. Air device finish shall be an anodic acrylic paint, baked at 315° F for 30 minutes.
1. The pencil hardness must be HB to H.
2. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film.
3. The paint must pass a 250-hour ASTM D870 Water Immersion Test.

I. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.

2.2 TYPE A: PLAQUE FACE SUPPLY DIFFUSER, STEEL

A. Architectural square panel ceiling diffusers shall be the TITUS Model OMNI (steel) diffuser of the sizes and mounting types shown on the plans and outlet schedule.

B. The diffuser shall have a 22-gauge steel face panel that captures a secondary 22-gauge panel. The face panel shall be removable by means of four hanger brackets. The exposed surface of the

face panel shall be smooth, flat, and free of visible fasteners. The face panel shall project ¼ inch below the outside border of the diffuser backpan. Panels projecting more than ¼ inch below the outside border are not acceptable.

C. The back of the face panel shall have an aerodynamically shaped, rolled edge to ensure a tight horizontal discharge pattern. A single metal thickness on the edges of the face panel will not be accepted.

D. Ceiling diffusers with a 24 x 24-inch full face shall have no less than an 18 x 18-inch face panel size. Ceiling diffusers with a 12 x 12-inch full face shall have no less than a 9 x 9-inch face panel size.

E. Opposed blade volume damper shall not be provided. Directional Blow clips shall be available to restrict the discharge air in certain directions.

F. Molded insulation blanket shall be provided. The insulation will be R-6, foil-backed, and provide an additional 1-inch gap around the neck to install insulated flex duct.

G. The grille finish shall be #26 white.

2.3 TYPE B: SIDEWALL DOUBLE DEFLECTION SUPPLY GRILLE, STEEL

A. Steel supply grilles shall be TITUS Model 300RL (double deflection) or approved equal of the sizes and mounting types shown on the plans and outlet schedule.

B. The deflection blades shall be available parallel to the long dimension of the grille. Construction shall be of steel with a 1¼-inch wide border on all sides. Screw holes shall be countersunk for a neat appearance. Corners shall be welded with full penetration resistance welds.

C. Deflection blades shall be contoured to a specifically designed and tested cross-section to meet published test performance data. Blades shall be spaced on ¾-inch centers. Blades shall have steel friction pivots on both ends to allow individual blade adjustment without loosening or rattling. Plastic blade pivots are not acceptable.

D. Opposed blade volume damper shall not be provided.

E. The grille finish shall be #26 white.

2.4 TYPE C: LINEAR SLOT SUPPLY DIFFUSER

A. Modulinear diffusers shall be TITUS model ML (supply) or approved equal with 1-inch slot spacing of the sizes and mounting types shown on the plans and outlet schedule.

B. Linear slot diffusers shall be available in standard one piece lengths up to 6 feet. Diffuser lengths greater than 6 feet shall be furnished in multiple sections and shall be joined together end-to-end with alignment pins to form a continuous slot appearance. All alignment components to be provided by the manufacturer.

C. The frame and support bars shall be constructed of heavy gauge extruded aluminum. The pattern controller shall be an aerodynamically curved "ice-tong" shaped steel deflector capable of 180° pattern adjustment from the face of the diffuser and shall allow dampering if required. Maximum pattern controller length shall be 3 feet, for diffusers longer than 3 feet pattern controllers shall be furnished in multiple sections.

D. Heavy gauge extruded aluminum end borders, end caps and mitered corners shall be available to close off the ends of the diffusers.

E. Externally insulated plenums shall be manufactured by the same manufacturer of the linear slot diffusers.

F. The finish shall be #26 white on the face and #84 black on the pattern controllers.

2.5 TYPE D: EGG CRATE RETURN GRILLE, STEEL

A. Egg crate ceiling register shall be TITUS model 50R (steel border, aluminum grid, flush face) or approved equal for return of the sizes and mounting types shown on the plans and outlet schedule.

B. Return grilles must provide a free area of at least 90%. Outer borders shall be constructed of heavy extruded aluminum and shall have countersunk screw holes for a neat appearance.

C. Border width shall be 1¼ inches on all sides and shall be interlocked at the four corners and mechanically staked to form a rigid frame. Aluminum grid shall be ½ x ½ x ½ inch.

D. The register shall have minimum 1 1/8-inch depth for easy duct connection.

E. Optional opposed blade volume damper shall not be provided.

F. Unless otherwise noted, the grille finish shall be #26 white.

2.6 TYPE E: EGG CRATE RETURN/EXHAUST GRILLE, ALUMINUM

A. Egg crate ceiling register shall be TITUS model 50F (aluminum border, aluminum grid, flush face) or approved equal for return of the sizes and mounting types shown on the plans and outlet schedule.

B. Return grilles must provide a free area of at least 90%. Outer borders shall be constructed of heavy extruded aluminum and shall have countersunk screw holes for a neat appearance.

C. Border width shall be 1¼ inches on all sides and shall be interlocked at the four corners and mechanically staked to form a rigid frame. Aluminum grid shall be ½ x ½ x ½ inch.

D. The register shall have minimum 1 1/8-inch depth for easy duct connection.

E. Optional opposed blade volume damper shall not be provided.

F. Unless otherwise noted, the grille finish shall be #26 white.

2.7 TYPE F: LINEAR SLOT RETURN DIFFUSER

A. Modulinear diffusers shall be TITUS model ML (supply) or approved equal with 1-inch slot spacing of the sizes and mounting types shown on the plans and outlet schedule.

B. Linear slot diffusers shall be available in standard one piece lengths up to 6 feet. Diffuser lengths greater than 6 feet shall be furnished in multiple sections and shall be joined together end-to-end with alignment pins to form a continuous slot appearance. All alignment components to be provided by the manufacturer.

C. The frame and support bars shall be constructed of heavy gauge extruded aluminum. The pattern controller shall be an aerodynamically curved "ice-tong" shaped steel deflector capable of 180° pattern adjustment from the face of the diffuser and shall allow dampering if required. Maximum pattern controller length shall be 3 feet, for diffusers longer than 3 feet pattern controllers shall be furnished in multiple sections.

D. Heavy gauge extruded aluminum end borders, end caps and mitered corners shall be available to close off the ends of the diffusers.

E. Externally insulated plenums shall be manufactured by the same manufacturer of the linear slot diffusers.

F. The finish shall be #26 white on the face and #84 black on the pattern controllers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

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

3.2 INSTALLATION

A. Install air devices level and plumb.

B. Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install air devices with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

D. Paint the ductwork behind registers with flat black enamel so that bright surface cannot be seen. Properly prime galvanized surface prior to painting.

3.3 ADJUSTING

A. After installation, adjust air devices to air patterns indicated, or as directed, before starting air balancing.

B. The position of the pattern controllers for linear supply diffusers shall be verified and adjusted during Testing, Adjusting and Balancing.

END OF SECTION 233713

SECTION 237416.13 - PACKAGED, LARGE-CAPACITY, ROOFTOP AIR-CONDITIONING UNITS

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 packaged, large-capacity, rooftop air conditioning units (RTUs) with the following components:

1. Casings.
2. Fans, drives, and motors.
3. Rotary heat exchanger.
4. Coils.
5. Refrigerant circuit components.
6. Air filtration.
7. Gas furnaces.
8. UV germicidal irradiation section.
9. Sound-attenuator section.
10. Dampers.
11. Electrical power connections.
12. Controls.
13. Roof curbs.
14. Accessories.

1.3 DEFINITIONS

A. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, large-capacity, rooftop air-conditioning units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

1.4 ACTION SUBMITTALS

A. Product Data: For each RTU.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
3. Include unit dimensions and weight.

4. Include cabinet material, metal thickness, finishes, insulation, and accessories.
5. Fans:
    a. Include certified fan-performance curves with system operating conditions indicated.
    b. Include certified fan-sound power ratings.
    c. Include fan construction and accessories.
    d. Include motor ratings, electrical characteristics, and motor accessories.
6. Include certified coil-performance ratings with system operating conditions indicated.
7. Include filters with performance characteristics.
8. Include gas furnaces with performance characteristics.
9. Include factory selection calculations for each antimicrobial ultraviolet lamp installation.
10. Include dampers, including housings, linkages, and operators.

B. Shop Drawings: For each packaged, large-capacity, rooftop air-conditioning units.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For RTU supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Include design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
2. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
3. Wind- and Seismic-Restraint Details: Detail fabrication and attachment of wind and seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and other details, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. Sample Warranty: For manufacturer's warranty.

C. Seismic Qualification Data: Certificates, for RTUs, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Restraint of internal components.

D. Product Certificates: Submit certification that specified equipment will withstand wind forces identified in "Performance Requirements" Article and in Section 230548 "Vibration and Seismic Controls for HVAC."

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Source quality-control reports.

F. System startup reports.

G. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set(s) of filters for each unit.
2. Gaskets: One set(s) for each access door.

1.8 WARRANTY

A. Warranty: Manufacturer agrees to repair or replace components of outdoor, semi-custom, air-handling unit that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year(s) from date of Substantial Completion.

2. Warranty Period for Compressor: Five years(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of RTUs and components.

C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE 15 Compliance: For refrigeration system safety.

E. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

F. UL Compliance: Comply with UL 1995.

G. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design mounting and restraints for RTUs, including comprehensive engineering analysis.

1. Design RTU supports to comply with wind and seismic performance requirements.

H. Wind-Restraint Performance:
1. Refer to structural drawings for wind loading requirements.

I. Seismic Performance: RTUs shall withstand the effects of earthquake motions determined according to ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified".
2. Component Importance Factor: **1.0**.

2.2 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Valent VX or comparable product by one of the following:
1. JCI/York
2. Trane
3. Valent

2.3 UNIT CASINGS

A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

B. Double-Wall Construction:

1. Outside Casing Wall: Galvanized steel, minimum 18 gauge thick with corrosion-resistant coating, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
2. Inside Casing Wall: G90-coated galvanized steel, 0.034 inch thick.
3. Floor Plate: G90 galvanized steel minimum 18 gauge thick.
4. Casing Insulation:

a. Materials: Injected polyurethane foam insulation.
b. Casing Panel R-Value: Minimum R13.
c. Insulation Thickness: 2 inches.
d. Thermal Break: Provide continuity of insulation with no through-casing metal in casing walls, floors, or roof of unit.

C. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.

D. Static-Pressure Classifications:

1. For Unit Sections Upstream of Fans: Minus 2-inch wg.
2. For Unit Sections Downstream and Including Fans: 3-inch wg.

E. Panels and Doors:

1. Panels:

a. Fabrication: Formed and reinforced with same materials and insulation thickness as casing.
b. Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against air-pressure differential.
c. Gasket: Neoprene, applied around entire perimeters of panel frames.
d. Size: Large enough to allow inspection and maintenance of air-handling unit's internal components. Dimensions to be at least 18 inches wide by full height of unit casing.

2. Access Doors:

a. Hinges: A minimum of two ball-bearing hinges or stainless steel piano hinge and two wedge-lever-type latches, operable from inside and outside. Arrange doors to be opened against air-pressure differential.
b. Gasket: Neoprene, applied around entire perimeters of panel frames.

c. Size: Large enough to allow inspection and maintenance of air-handling unit's internal components. Dimensions to be at least 18 inches wide by full height of unit casing.

3. Locations and Applications:

a. Fan Section: Doors and inspection and access panels.
b. Access Section: Doors.
c. Coil Section: Inspection and access panels.
d. Damper Section: Doors.
e. Filter Section: Doors large enough to allow periodic removal and installation of filters.
f. Mixing Section: Doors.

4. Service Light: 100-W vaporproof fixture with switched junction box located outside adjacent to door.

a. Locations: Fan section.

F. Condensate Drain Pans:

1. Location: Each type of cooling coil.
2. Construction:

a. Single-wall, stainless steel sheet.

3. Drain Connection:

a. Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
b. Minimum Connection Size: NPS 1.

4. Slope: Minimum 0.125-in./ft. slope, to comply with ASHRAE 62.1, in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers and to direct water toward drain connection.
5. Length: Extend drain pan downstream from leaving face for distance to comply with ASHRAE 62.1.
6. Width: Entire width of water producing device.
7. Depth: A minimum of 2 inches deep.
8. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

2.4 FANS, DRIVES, AND MOTORS

A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.

B. Supply-Air Fans: Centrifugal, rated according to AMCA 210; galvanized or painted steel; mounted on solid-steel shaft.

1. Shafts: With field-adjustable alignment.

    a. Turned, ground, and polished hot-rolled steel with keyway.

2. Shaft Bearings:

    a. Heavy-duty, self-aligning, pillow-block type with an L-50 rated life of minimum 100,000 hours according to ABMA 9.

3. Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.

    a. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.

4. Centrifugal Fan Wheels: Inlet flange, backplate, and shallow blades with inlet and tip curved forward in direction of airflow and mechanically fastened to flange and backplate; steel or aluminum hub swaged to backplate and fastened to shaft with setscrews.
5. Mounting: For internal vibration isolation and seismic control. Factory-mount fans with manufacturer's standard vibration isolation mounting devices having a minimum static deflection of 1 inch.
6. Shaft Lubrication Lines: Extended to a location outside the casing.
7. Flexible Connector: Factory fabricated with a fabric strip minimum 3-1/2 inches wide, attached to two strips of minimum 2-3/4-inch-wide by 0.028-inch-thick, galvanized-steel sheet.

    a. Flexible Connector Fabric: Glass fabric, double coated with neoprene. Fabrics, coatings, and adhesives shall comply with UL 181, Class 1.

C. Drives, Direct: Factory-mounted, direct drive.

D. Condenser-Coil Fan: Variable-speed propeller, mounted on shaft of permanently lubricated ECM motors.

E. Relief-Air Fan: Similar construction to supply fan.

F. Motors:

1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
2. 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.
3. Enclosure Type: Open, dripproof.
4. Enclosure Materials: Cast iron.

5. Efficiency: Premium efficient as defined in NEMA MG 1.
6. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

2.5 COILS

A. General Requirements for Coils:

1. Comply with AHRI 410.
2. Fabricate coils section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
3. Coils shall not act as structural component of unit.

B. Supply-Air Refrigerant Coil:

1. Tubes: Copper.
2. Fins:
    a. Material: Aluminum.
    b. Fin Spacing: Maximum 10 fins per inch.
3. Fin and Tube Joints: Mechanical bond.
4. Headers: Seamless-copper headers with brazed connections.
5. Frames: Galvanized steel.
6. Coatings: Corrosion-resistant coating.
7. Ratings: Designed, tested, and rated according to ASHRAE 33 and AHRI 410.
    a. Working Pressure: Minimum 300 psig.

2.6 REFRIGERANT CIRCUIT COMPONENTS

A. Number of Refrigerant Circuits: Two.

B. Compressor: Hermetic, variable speed scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.

C. 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 installed in compressor suction and liquid lines.
9. Low-ambient kit high-pressure sensor.

2.7 AIR FILTRATION

A. Particulate air filtration is specified in Section 234100 "Particulate Air Filtration."

B. Panel Filters:

1. Description: Flat, non-pleated factory-fabricated, self-supported, disposable air filters with holding frames.
2. Filter Unit Class: UL 900.
3. Media: Interlaced glass, synthetic or cotton fibers coated with nonflammable adhesive and antimicrobial coating.
4. Filter-Media Frame: Beverage board with perforated metal retainer, or metal grid, on outlet side.

C. Adhesive, Sustainability Projects: As recommended by air-filter manufacturer and with a VOC content of 80 g/L or less.

2.8 DAMPERS

A. Dampers: Comply with requirements in Section 230923.12 "Control Dampers."

B. Outdoor- and Return-Air Dampers: Low-leakage, double-skin, airfoil-blade, galvanized-steel dampers with compressible jamb seals and extruded-vinyl blade edge seals in opposed-blade arrangement with zinc-plated steel operating rods rotating in sintered bronze or bearings mounted in a single galvanized-steel frame, and with operating rods connected with a common linkage. Leakage rate shall not exceed 4 cfm/sq. ft. at 1-inch wg and 8 cfm/sq. ft at 4-inch wg.

C. Barometric relief dampers.

D. Damper Operators: Comply with requirements in Section 230923.12 "Control Dampers."

2.9 ELECTRICAL POWER CONNECTIONS

A. RTU shall have a single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

2.10 CONTROLS

A. Interface Requirements for HVAC Instrumentation and Control System:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.
3. Provide BACnet compatible interface for central HVAC control workstation for the following:

    a. Adjusting set points.
    b. Monitoring supply fan start, stop, and operation.
    c. Inquiring data to include outdoor-air damper position, supply- and room-air temperature and humidity.
    d. Monitoring occupied and unoccupied operations.

e. Monitoring constant and variable motor loads.
f. Monitoring variable-frequency drive operation.
g. Monitoring cooling load.
h. Monitoring economizer cycles.
i. Monitoring air-distribution static pressure and ventilation air volume.

2.11 ROOF CURBS

A. Roof curbs with vibration isolators and wind or seismic restraints are specified in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Wind and Seismic Restraints: Metal brackets compatible with the curb and casing, painted to match RTU, used to anchor unit to the curb, and designed for loads at Project site. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for wind-load requirements.

C. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.

1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

a. Materials: ASTM C1071, Type I or II.
b. Thickness: 2 inch.

2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.

a. Liner Adhesive: Comply with ASTM C916, Type I.
b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
d. Liner Adhesive: Comply with ASTM C916, Type I.

D. Curb Dimensions: Height of 36 inches.

2.12 ACCESSORIES

A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.

B. Low-ambient kit using variable-speed condenser fans for operation down to 35 deg F.

C. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.

D. Remote potentiometer to adjust minimum economizer damper position.

E. Return-air bypass damper.

F. Factory- or field-installed demand-controlled ventilation.

G. Safeties:
1. Condensate overflow switch.
2. Phase-loss reversal protection.
3. High and low pressure control.

H. Coil guards of painted, galvanized-steel wire.

I. Hail guards of galvanized steel, painted to match casing.

J. Concentric diffuser with white louvers and polished aluminum return grilles, insulated diffuser box with mounting flanges, and interior transition.

K. Door switches to disable heating or reset set point when open.

L. Outdoor air intake ducted connection.

M. Service Lights and Switch: Factory installed in fan section with weatherproof cover. Factory wire lights to a single-point field connection.

2.13 MATERIALS

A. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for steel sheet.

B. Stainless Steel:

1. Manufacturer's standard grade for casing.
2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.

C. Galvanized Steel: ASTM A653/A653M.

D. Aluminum: ASTM B209.

E. Corrosion-Resistant Coating: Coat with a corrosion-resistant coating capable of withstanding a **10,000**-hour salt-spray test according to ASTM B117.

1. Standards:

a. ASTM B117 for salt spray.
b. ASTM D2794 for minimum impact resistance of 100 in-lb
c. ASTM B3359 for cross-hatch adhesion of 5B.

2.14 SOURCE QUALITY CONTROL

A. AHRI Compliance:

1. Comply with AHRI 340/360 for testing and rating energy efficiencies for RTUs.
2. Comply with AHRI 210/240 for testing and rating energy efficiencies for RTUs

B. AMCA Compliance:

1. Comply with AMCA 11 and bear the AMCA-Certified Ratings Seal for air and sound performance according to AMCA 211 and AMCA 311.
2. Damper leakage tested in accordance with AMCA 500-D.
3. Operating Limits: Classify according to AMCA 99.

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 for suitable conditions where RTUs will be installed.

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

3.2 INSTALLATION

A. Roof Curb: Install on roof structure or concrete base, level and secure, according to Manufacturer's requirements. Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 077200 "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts. Coordinate sizes and locations of roof curbs with actual equipment provided.

B. Equipment Mounting:

1. Install RTUs on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

3.3 PIPING CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to RTU, allow space for service and maintenance.

C. Connect piping to unit mounted on vibration isolators with flexible connectors.

D. Connect condensate drain pans using NPS 1-1/2, ASTM B88, Type M copper tubing. Extend to nearest equipment or roof drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

E. Refrigerant Piping: Comply with applicable requirements in Section 232300 "Refrigerant Piping." Install shutoff valve and union or flange at each supply and return connection.

3.4 DUCT CONNECTIONS

A. Comply with duct installation requirements specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:

1. Install ducts to termination at top of roof curb.
2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
3. Connect supply ducts to RTUs with flexible duct connectors specified in Section 233300 "Air Duct Accessories."
4. Install return-air duct continuously through roof structure.

3.5 ELECTRICAL CONNECTIONS

A. Connect electrical wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate shall be laminated acrylic or melamine plastic signs as specified in Section 260553 "Identification for Electrical Systems."
2. Locate nameplate where easily visible.

3.6 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.7 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.

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to furnace combustion chamber.
3. Inspect for visible damage to compressor, coils, and fans.
4. Inspect internal insulation.
5. Verify that labels are clearly visible.
6. Verify that clearances have been provided for servicing.
7. Verify that controls are connected and operable.
8. Verify that filters are installed.
9. Clean condenser coil and inspect for construction debris.
10. Remove packing from vibration isolators.
11. Inspect operation of barometric relief dampers.
12. Verify lubrication on fan and motor bearings.
13. Start unit according to manufacturer's written instructions.

    a. Start refrigeration system.
    b. Do not operate below recommended low-ambient temperature.
    c. Complete startup sheets and attach copy with Contractor's startup report.

14. Inspect and record performance of interlocks and protective devices; verify sequences.
15. Operate unit for an initial period as recommended or required by manufacturer.

16. Calibrate thermostats.
17. Adjust and inspect high-temperature limits.
18. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
19. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:

    a. Coil leaving-air, dry- and wet-bulb temperatures.
    b. Coil entering-air, dry- and wet-bulb temperatures.
    c. Outdoor-air, dry-bulb temperature.
    d. Outdoor-air-coil, discharge-air, dry-bulb temperature.

20. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
21. 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-air volume.
    d. Outdoor-air intake volume.

22. Simulate maximum cooling demand and inspect 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.

23. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:

a. High-temperature limit on gas-fired heat exchanger.
b. Low-temperature safety operation.
c. Filter high-pressure differential alarm.
d. Economizer to minimum outdoor-air changeover.
e. Relief-air fan operation.
f. Smoke and firestat alarms.

24. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.8 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.9 CLEANING

A. After completing system installation and testing, adjusting, and balancing RTUs and air-distribution systems and after completing startup service, clean RTUs internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

3.10 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. RTU will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs.

END OF SECTION 237416.13

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. Copper building wires and cables rated 600 V and less.
2. Fire-alarm wire and cable
3. 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, provide products by the following:
1. Alcan Products Corporation; Alcan Cable Division.
2. Alpha Wire.
3. Belden Inc.
4. Encore Wire Corporation.
5. General Cable Technologies Corporation.
6. Southwire Incorporated.

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 and UL 83.

2.2 FIRE-ALARM WIRE AND CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Allied Wire & Cable Inc.
2. CommScope, Inc.
3. Comtran Corporation.
4. Draka Cableteq USA; a Prysmian Group company.
5. Genesis Cable Products; Honeywell International, Inc.
6. Radix Wire.
7. Rockbestos-Suprenant Cable Corp.
8. Superior Essex Inc.
9. West Penn Wire.

B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

C. Signaling Line Circuits: Twisted, shielded pair, not less than No. 18 AWG size or as recommended by system manufacturer for voltage drop.
1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.

D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.
1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.

2.3 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. AFC Cable Systems, Inc.
2. Gardner Bender.
3. Hubbell Power Systems, Inc.
4. Ideal Industries, Inc.
5. Ilsco; a branch of Bardes Corporation.
6. NSi Industries LLC.
7. O-Z/Gedney; a brand of the EGS Electrical Group.
8. 3M; Electrical Markets Division.
9. Tyco Electronics.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.4 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with 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.

C. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-2-THWN-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. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-2-THWN-2, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.

H. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller. In raceway colored/painted red.

I. 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. Each branch circuit shall have an individual neutral conductor. Increasing the neutral conductor size, or "super neutral," is not allowed for multiple branch circuits.

B. Feeders and branch circuits shall have a ground conductor.

C. Install no more than 3 phase wires in any feeder or branch circuit conduit.

D. Wire size on 120 Volt, 20 ampere branch circuit home run conductors over 75 feet in length (from closest wiring device at the home run designation to the associated panelboard shown on the electrical drawing sheets), shall be increased to No. 10 AWG (minimum) to limit excessive voltage drop.

E. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

F. 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.

G. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

H. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

I. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

J. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 INSTALLATION OF FIRE-ALARM WIRE AND CABLE

A. Comply with NFPA 72.

B. Wiring Method: Install wiring in red metal pathway.
   1. Install plenum cable in environmental airspaces, including plenum ceilings.
   2. Fire-alarm circuits and equipment control wiring associated with fire-alarm system must be installed in a dedicated pathway system.
      a. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.
   3. Signaling Line Circuits: Power-limited fire-alarm cables may be installed in the same cable or pathway as signaling line circuits.

C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with

fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes; cabinets; or equipment enclosures where circuit connections are made.

E. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.

F. Wiring to Remote Alarm Transmitting Device: 1 inch conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 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. Feeder splices shall be approved by the engineer. Where approved splices shall utilize split bolt or crimp type connections. Polaris plugs are not approved for use.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

D. Comply with requirements in Section 284621 "Addressable Fire-Alarm Systems" for connecting, terminating, and identifying wires and cables.

3.6 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.

3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.8 FIRESTOPPING

A. Apply fire stopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.9 FIELD QUALITY CONTROL

A. 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.

B. 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.

C. 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 systems and equipment.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency and testing agency's field supervisor.

B. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.
   1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 CONDUCTORS

A. 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. Lexan or PVC, impulse tested at 5000 V. Ground bars shall be 16" long in main electrical room and 10" in all other rooms.

2.3 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
1. Pipe Connectors: Clamp type, sized for pipe.

D. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

E. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

F. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

G. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

2.4 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet in diameter.

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 tinned-copper conductor, No. 3/0 AWG minimum.
   1. Bury at least 24 inches below grade.
   2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.

C. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
   1. Install bus 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 to specified height above floor; connect to horizontal bus.

D. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
   3. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.4 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.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

3.5 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. 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.

C. 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.

D. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.

E. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.6 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
   1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
   2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.
   1. Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
   3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:
   1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
   2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
   3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

F. 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.

G. 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. 3/0 AWG for ground ring and for taps to building steel.
   2. Bury ground ring not less than 24 inches from building's foundation.

H. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 feet long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.

I. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:
   1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
   2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
   3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
      a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
      b. Perform tests by fall-of-potential method according to IEEE 81.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. 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).

F. 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. Include design calculations for seismic restraints.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Steel slotted support systems.
   2. Nonmetallic slotted support systems.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
   1. Trapeze hangers. Include Product Data for components.
   2. Steel slotted channel systems. Include Product Data for components.
   3. Nonmetallic slotted channel systems. Include Product Data for components.
   4. Equipment supports.

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.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. ERICO International Corporation.
d. GS Metals Corp.
e. Thomas & Betts Corporation.
f. Unistrut; Tyco International, Ltd.
g. Wesanco, Inc.
2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Hilti Inc.
      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.
      4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Cooper B-Line, Inc.; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti Inc.
      4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      5) MKT Fastening, LLC.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

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 IBC. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
   1. Secure raceways and cables to these supports with two-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. 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. Provide vibration and seismic controls with hangers and supports in accordance with requirements specified in Section 260548 "Vibartion and Seismic Controls for Electrical Systems"

D. 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.

E. 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: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
   6. To Light Steel: Sheet metal screws.
   7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

F. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

B. Field Welding: Comply with AWS D1.1/D1.1M.

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. Boxes, enclosures, and cabinets.

B. Related Requirements:
   1. Section 078413 "Penetration Firestopping" for firestopping at conduit and box entrances.
   2. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
   3. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

1.3 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

B. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For 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, provide products by the following:
1. AFC Cable Systems, Inc.
2. Allied Tube & Conduit; a Tyco International Ltd. Co.
3. Anamet Electrical, Inc.
4. Electri-Flex Company.
5. O-Z/Gedney; a brand of EGS Electrical Group.
6. Picoma Industries, a subsidiary of Mueller Water Products, Inc.
7. Republic Conduit.
8. Robroy Industries.
9. Southwire Company.
10. Thomas & Betts Corporation.
11. Western Tube and Conduit Corporation.
12. Wheatland Tube Company; a division of John Maneely Company.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. ARC: Comply with ANSI C80.5 and UL 6A.

E. IMC: Comply with ANSI C80.6 and UL 1242.

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.
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 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Adalet.
2. Cooper Technologies Company; Cooper Crouse-Hinds.
3. EGS/Appleton Electric.
4. Erickson Electrical Equipment Company.
5. FSR Inc.
6. Hoffman; a Pentair company.
7. Hubbell Incorporated; Killark Division.
8. Kraloy.
9. Milbank Manufacturing Co.
10. Mono-Systems, Inc.
11. O-Z/Gedney; a brand of EGS Electrical Group.
12. RACO; a Hubbell Company.
13. Robroy Industries.
14. Spring City Electrical Manufacturing Company.
15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
16. Thomas & Betts Corporation.
17. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. 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. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

I. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

J. Device Box Dimensions: 4 inches square by 2-1/8 inches deep and 4 inches by 2-1/8 inches by 2-1/8 inches deep

K. Gangable boxes are prohibited.

L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC or IMC.
2. Concealed Conduit, Aboveground: EMT.
3. Concealed Conduit, Aboveground within concrete beams and columns: RNC, Type EPC-40-PVC with rigid steel conduit elbows.
4. Concealed Conduit, In concrete slab: RNC, Type EPC-40-PVC with rigid steel conduit elbows for feeder conduits. Approval by structural engineer required.
5. Underground Conduit: RNC, Type EPC-40-PVC with rigid steel conduit elbows for power service, telecom service and generator conduits.
6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
7. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
5. Damp or Wet Locations: EMT.

C. Minimum Raceway Size: 3/4 inch.

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, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install surface raceways only where indicated on Drawings or prior approved by architect/engineer.

F. 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 and ceilings unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches of enclosures to which attached. Provide support straps intended for this type of installation.

I. Raceways Embedded in Slabs:
   1. Conduit can be installed in the slabs where approved by structural engineer.

J. 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.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

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. 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.

S. 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.

T. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

U. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
   d. Attics: 135 deg F temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

V. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed 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. Install boxes with height measured to top of box unless otherwise indicated. All adjacent boxes shall be aligned horizontally on the same wall.

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. Large metal wireways and auxiliary gutters shall be approved by engineer of record before installation.

3.3 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."

3.4 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Install firestopping putty pads at backbox locations in fire-rated wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 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 260543 - UNDERGROUND DUCTS AND RACEWAYS 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. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks, and in single duct runs.
   2. Handholes and boxes.

1.3 DEFINITION

A. RNC: Rigid nonmetallic conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Duct-bank materials, including separators and miscellaneous components.
   2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
   3. Accessories for handholes, boxes.
   4. Warning tape.
   5. Warning planks.

B. Shop Drawings for Factory-Fabricated Handholes and Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:
   1. Duct entry provisions, including locations and duct sizes.
   2. Cover design.
   3. Grounding details.
   4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.5 INFORMATIONAL SUBMITTALS

A. Source quality-control test reports.

B. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Comply with ANSI C2.

B. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

1.8 COORDINATION

A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.

B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

PART 2 - PRODUCTS

2.1 CONDUIT

A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.

B. RNC: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ARNCO Corp.
2. Beck Manufacturing.
3. Cantex, Inc.
4. CertainTeed Corp.; Pipe & Plastics Group.
5. Condux International, Inc.
6. ElecSys, Inc.
7. Electri-Flex Company.
8. IPEX Inc.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT; a division of Cable Design Technologies.

11. Spiraduct/AFC Cable Systems, Inc.

B. Duct Accessories:
1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
2. Warning Tape: Underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."
3. Concrete Warning Planks: Nominal 12 by 24 by 3 inches in size, manufactured from 6000-psi concrete.
   a. Mark each plank with "ELECTRIC" in 2-inch- high, 3/8-inch- deep letters.

2.3 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Description: Comply with SCTE 77.
1. Color: Match color of installed surface.
2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC, TRAFFIC, TELECOMMUNICATIONS" etc.
6. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
7. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 inches wide by 24 inches long unless otherwise noted shall have factory-installed inserts for cable racks and pulling-in irons.

B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Armorcast Products Company.
   b. Carson Industries LLC.
   c. Channell Corp.
   d. CDR Systems Corporation.
   e. NewBasis.

PART 3 - EXECUTION

3.1 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Feeders 600 V and More: RNC**,** NEMA Type EPC-40-PVC, unless otherwise indicated.

B. Ducts for Electrical Feeders 600 V and Less: RNC**,** NEMA Type EPC-40-PVC, unless otherwise indicated.

C. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.

D. Ducts for Electrical Feeders and Ducts for Fiber (Telecomm) shall be kept a minimum of 24" apart.

3.2 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes and Boxes for 600 V and Less:
1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-10 structural load rating.
2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer concrete units, SCTE 77, Tier 8 structural load rating.

3.3 EARTHWORK

A. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

B. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching.

C. Cut and patch existing pavement in the path of underground ducts and utility structures.

3.4 DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.

B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations, unless otherwise indicated.

C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.
   1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.
   2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
   3. Grout end bells into structure walls from both sides to provide watertight entrances.

E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 5 feet outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition.

F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.

G. Pulling Cord: Install 100-lbf- test nylon cord in ducts, including spares.

H. Direct-Buried Duct Banks:
   1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
   2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers.
   3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms for pipes less than 6 inches in nominal diameter.
   4. Install backfill.
   5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction.
   6. Depth: Install top of duct bank at least 36 inches below finished grade, unless otherwise indicated. Coordinate with structural foundation.
   7. Install manufactured rigid steel conduit elbows for power service, telecom service and generator service at building entrances through the floor.

a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

8. Warning Planks: Bury warning planks approximately 12 inches above direct-buried ducts and duct banks, placing them 24 inches o.c. Align planks along the width and along the centerline of duct bank. Provide an additional plank for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional planks 12 inches apart, horizontally.

3.5 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.

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 and trafficways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch above finished grade.

D. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

E. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.
1. Concrete: 3000 psi, 28-day strength.
2. Dimensions: 10 inches wide by 12 inches deep.

3.6 GROUNDING

A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:
1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.

2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
3. Test handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

END OF SECTION 260543

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.

B. Related Requirements:
1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

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. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. 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, provide products by the following:
a. Advance Products & Systems, Inc.
b. CALPICO, Inc.
c. Metraflex Company (The).
d. Pipeline Seal and Insulator, Inc.
e. 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, provide products by the following:
a. Presealed Systems.

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.
   2. Sealant shall have VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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 or unless seismic criteria require different clearance.
   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.
   5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

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 steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

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 260548 - VIBRATION AND SEISMIC CONTROLS 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. Isolation pads.
2. Spring isolators.
3. Restrained spring isolators.
4. Channel support systems.
5. Restraint cables.
6. Hanger rod stiffeners.
7. Anchorage bushings and washers.

B. Related Sections include the following:
1. Section 260529 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 DEFINITIONS

A. The IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:
1. See Structural Code Sheet.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:
1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES.
b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.
   a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other electrical Sections for equipment mounted outdoors.
2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
3. Field-fabricated supports.
4. Seismic-Restraint Details:
   a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
   b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
   c. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.

B. Qualification Data: For professional engineer.

C. Welding certificates.

D. Field quality-control test reports.

1.7 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

D. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. California Dynamics Corporation.
4. Isolation Technology, Inc.
5. Kinetics Noise Control.
6. Mason Industries.
7. Vibration Eliminator Co., Inc.
8. Vibration Isolation.
9. Vibration Mountings & Controls, Inc.

B. Pads: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
1. Resilient Material: Oil- and water-resistant neoprene.

C. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.2 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Cooper B-Line, Inc.; a division of Cooper Industries.
4. Hilti Inc.
5. Loos & Co.; Seismic Earthquake Division.
6. Mason Industries.
7. TOLCO Incorporated; a brand of NIBCO INC.
8. Unistrut; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an evaluation service member of ICC-ES.
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: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

D. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

E. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod. Do not weld stiffeners to rods.

F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.

G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.

H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless

steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.3 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive seismic and wind-load control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

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

3.2 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry static, wind load, and seismic loads within specified loading limits.

3.3 INSTALLATION OF SEISMIC-RESTRAINT AND WIND-LOAD CONTROL DEVICES

A. Provide seismic restraint and wind-load control devices for systems and equipment where indicated in Equipment Schedules or Seismic and Wind-Load Controls Schedule, where

indicated on Drawings, where the Specifications indicate they are to be installed on specific equipment and systems, and where required by applicable codes.

1. Install equipment and devices to withstand the effects of earthquake motions and high wind events.

B. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

C. Installation of seismic and wind-load restraints must not cause any stresses, misalignment, or change of position of equipment or conduits.

D. Equipment Restraints:
1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
2. Install seismic-restraint and wind-load-restraint devices using methods approved by an evaluation service member of ICC-ES that provides required submittals for component.

E. Raceway, Cable, Wireway, Cable Tray, and Busway Support and Hanger Restraints:
1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
2. Install seismic-restraint and wind-load-restraint devices using methods approved by an evaluation service member of ICC-ES that provides required submittals for component.
3. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
4. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.

F. Install cables so they do not bend across edges of adjacent equipment or building structure.

G. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

H. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

I. Post-Installed Concrete Anchors:
1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Mechanical-Type Anchor Bolts: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors must be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive-Type Anchor Bolts: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of

the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

5. Set anchors to manufacturer's recommended torque using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after isolated equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 260548

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.

E. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

F. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

G. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch- wide black stripes on 10-inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.

H. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

I. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.2 METAL-CLAD 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. Colors for Cables Carrying Circuits at 600 V and Less:
1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

C. 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.

D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

E. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.

2.3 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.

C. Self-Adhesive, Self-Laminating Polyester Labels: Write-on, 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 cable diameter such that the clear shield overlaps the entire printed legend.

D. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.

E. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

F. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

G. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

H. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

2.4 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: Write-on, 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.

C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.

D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.

E. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around conductor it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.

F. Marker Tapes: Vinyl or viny -cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

G. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
   1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
   2. Labels for Tags: Self-adhesive label, machine-printed with permanent, waterproof, black ink recommended by printer manufacturer, sized for attachment to tag.

2.5 FLOOR MARKING TAPE

A. 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

2.6 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical 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,.

2.7 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:
1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 7 by 10 inches.

D. Warning label and sign shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
3. Arc Flash Warning: "Danger -Arc Flash Hazard " or "Warning – Arc Flash Hazard"

2.8 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.

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.9 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

C. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

D. 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.

2.10 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.

2.11 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. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.

G. 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. MUSC standard coloring:

1. Fire Alarm System: Red
2. Mechanical Controls System: Blue
3. Telecommunication and Security System: Brown
4. Life Safety Emergency Power System: Yellow

H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

I. 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.

J. 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 trenchexceeds 16 inches overall.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Self-adhesive vinyl labels. Install labels at 10-foot maximum intervals.

B. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 30-foot maximum intervals.
1. Power feeders and branch circuits – Orange background with voltage named.
2. Lighting feeders and branch circuits – yellow background with voltage named.
3. Telephone and communications circuits – blue background with system named.

C. Conduit markers are to be placed at all junctions and terminations of raceways. Markers shall be visible and unobstructed.

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 and feeder conductors.
      a. Color shall be factory applied[or field applied for sizes larger than No. 8 AWG.
      b. Colors for 208/120-V Circuits:
         1) Phase A: Black.
         2) Phase B: Red.
         3) Phase C: Blue.
      c. Colors for 480/277-V Circuits:
         1) Phase A: Brown.
         2) Phase B: Orange.
         3) Phase C: Yellow.
      d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings. Conductors smaller than #6 AWG are to be color coded with a solid color insulation.

E. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use write-on tags.

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 vinyl labels with the conductor or cable designation, origin, and destination.

H. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive vinyl labels with the conductor designation.

I. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

J. 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.

K. 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.

L. Workspace Indication for electric wall heaters: 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.

M. 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.

N. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to 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. 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.
   e. Use red labels for emergency power.
2. Equipment to Be Labeled:
   a. Switchboards: Provide identification for each breaker next to each breaker.
   b. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label. Panelboard label shall indicate name, voltage, phase, and panel fed from.
   c. Enclosures and electrical cabinets.
   d. Access doors and panels for concealed electrical items.
   e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
   f. Enclosed switches.
   g. Enclosed circuit breakers.
   h. Enclosed controllers.
   i. Variable-speed controllers.
   j. Automatic Transfer Switches.

k. Receptacle faceplates and floor boxes.
l. All components and equipment in the fire communication center.

END OF SECTION 260553

SECTION 260573 - ARC-FLASH HAZARD ANALYSIS

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 a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.3 DEFINITIONS

A. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.

B. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.

D. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.

E. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

F. SCCR: Short-circuit current rating.

G. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

H. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form:
   1. Arc-flash study input data, including completed computer program input data sheets.
   2. Arc-flash study report; signed, dated, and sealed by Power Systems Analysis Specialist and Professional Engineer.
   3. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data:
   1. For Power Systems Analysis Software Developer.
   2. For Power System Analysis Specialist.
   3. For Field Adjusting Agency.

B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:
   1. Provide maintenance procedures in equipment manuals according to requirements in NFPA 70E.
   2. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.7 QUALITY ASSURANCE

A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms shall comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

D. Power System Analysis Software Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
   1. Computer program shall be designed to perform arc-flash analysis or have a function, component, or add-on module designed to perform arc-flash analysis.
   2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

E. Power Systems Analysis Specialist Qualifications: Professional engineer in charge of performing the arc-flash study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

F. Arc-Flash Study Certification: Arc-Flash Study Report shall be signed and sealed by Power Systems Analysis Specialist.

G. Field Adjusting Agency Qualifications:
1. Employer of a NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification responsible for all field adjusting of the Work.
2. A member company of NETA.
3. Acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CGI CYME.
2. EasyPower, LLC (formerly ESA Inc.).
3. EDSA Micro Corporation.
4. ESA Inc.
5. Operation Technology, Inc.
6. Power Analytics, Corporation.
7. SKM Systems Analysis, Inc.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.2 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram, showing the following:
1. Protective device designations and ampere ratings.
2. Conductor types, sizes, and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings, including derating factors and environmental conditions.
4. Motor and generator designations and kVA ratings.

5. Switchgear, switchboard, motor-control center, panelboard designations, and ratings.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output Data: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260574 "Short-Circuit Studies."

F. Protective Device Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260575 "Coordination Studies."

G. Arc-Flash Study Output Reports:
1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in the report:
   a. Voltage.
   b. Calculated symmetrical fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. No AC Decrement (NACD) ratio.
   e. Equivalent impedance.
   f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
   g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

H. Incident Energy and Flash Protection Boundary Calculations:
1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
4. Arc-flash boundary.
5. Restricted approach boundary.
6. Limited approach boundary.
7. Working distance.
8. Incident energy.
9. Hazard risk category.
10. Recommendations for arc-flash energy reduction.

I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of computer printout.

2.3 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis.

B. Label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
1. Location designation.
2. Nominal voltage.
3. Protection boundaries.

a. Arc-flash boundary.
b. Restricted approach boundary.
c. Limited approach boundary.
4. Arc flash PPE category.
5. Required minimum arc rating of PPE in Cal/cm squared.
6. Available incident energy.
7. Working distance.
8. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Preparatory Studies: Perform the Short-Circuit and Protective Device Coordination studies prior to starting the Arc-Flash Hazard Analysis.
1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260574 "Short-Circuit Studies."
2. Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260575 "Coordination Studies."

C. Calculate maximum and minimum contributions of fault-current size.
1. Maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
2. Calculate arc-flash energy at 85 percent of maximum short-circuit current according to IEEE 1584 recommendations.
3. Calculate arc-flash energy at 38 percent of maximum short-circuit current according to NFPA 70E recommendations.
4. Calculate arc-flash energy with the utility contribution at a minimum and assume no motor contribution.

D. Calculate the arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.

E. Include medium- and low-voltage equipment locations.

F. Calculate the limited, restricted, and prohibited approach boundaries for each location.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
   1. Fault contribution from induction motors shall not be considered beyond three to five cycles.
   2. Fault contribution from synchronous motors and generators shall be decayed to match the actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

H. Arc-flash energy shall generally be reported for the maximum of line or load side of a circuit breaker. However, arc-flash computation shall be performed and reported for both line and load side of a circuit breaker as follows:
   1. When the circuit breaker is in a separate enclosure.
   2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.3 POWER SYSTEM DATA

A. Obtain all data necessary for conduct of the arc-flash hazard analysis.
   1. Verify completeness of data supplied on one-line diagram on Drawings and under "Preparatory Studies" Paragraph in "Arc-Flash Hazard Analysis" Article. Call discrepancies to Architect's attention.
   2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.

B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:
   1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
   2. Obtain electrical power utility impedance or available short circuit current at the service.
   3. Power sources and ties.
   4. Short-circuit current at each system bus (three phase and line to ground).
   5. Full-load current of all loads.
   6. Voltage level at each bus.
   7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
   8. For reactors, provide manufacturer and model designation, voltage rating and impedance.

9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
13. Motor horsepower and NEMA MG 1 code letter designation.
14. Low-voltage conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
15. Medium-voltage conductor sizes, lengths, conductor material, conductor construction and metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).

3.4 LABELING

A. Apply one arc-flash label on the front cover of each section of the equipment for each equipment included in the study. Base arc-flash label data on highest values calculated at each location.

B. Each piece of equipment listed below shall have an arc-flash label applied to it:
1.
2. Medium Voltage Switch
3. Low-voltage switchboard.
4. Low voltage transformers.
5. Panelboard and safety switch over 250 V.
6. Panelboard and safety switch under 250 V.
7. Automatic transfer switch.

C. Note on record Drawings the location of equipment where the personnel could be exposed to arc-flash hazard during their work.
1. Indicate arc-flash energy.
2. Indicate protection level required.

3.5 APPLICATION OF WARNING LABELS

A. Install arc-flash warning labels under the direct supervision and control of Power System Analysis Specialist.

3.6 DEMONSTRATION

A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in potential arc-flash hazards associated with working on energized equipment and the significance of arc-flash warning labels.

END OF SECTION 260573

SECTION 260574 - SHORT-CIRCUIT STUDIES

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 a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

1.3 DEFINITIONS

A. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.

B. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.

D. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.

E. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.

F. SCCR: Short-circuit current rating.

G. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

H. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS

A. Product Data:
   1. For computer software program to be used for studies.

2. Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
    a. Short-circuit study input data, including completed computer program input data sheets.
    b. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.
        1) Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
        2) Revised one-line diagram, reflecting field investigation results and results of short-circuit study.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data:
1. For Power Systems Analysis Software Developer.
2. For Power System Analysis Specialist and Professional Engineer.
3. For Field Adjusting Agency.

B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:
1. For overcurrent protective devices to include in emergency, operation, and maintenance manuals.
2. The following are from the Short-Circuit Study Report:
    a. Final one-line diagram.
    b. Final Short-Circuit Study Report.
    c. Short-circuit study data files.
    d. Power system data.

1.7 QUALITY ASSURANCE

A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms shall comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.
1. Power System Analysis Software Qualifications: Computer program shall be designed to perform short-circuit studies or have a function, component, or add-on module designed to perform short-circuit studies.

2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

D. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

E. Short-Circuit Study Certification: Short-Circuit Study Report shall be signed and sealed by Power Systems Analysis Specialist.

F. Field Adjusting Agency Qualifications:
1. Employer of a NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification responsible for all field adjusting of the Work.
2. A member company of NETA.
3. Acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CGI CYME.
2. EasyPower, LLC (formerly ESA Inc.).
3. EDSA Micro Corporation.
4. ESA Inc.
5. Operation Technology, Inc.
6. Power Analytics, Corporation.
7. SKM Systems Analysis, Inc.

B. Comply with IEEE 399 and IEEE 551.
1. Analytical features of power systems analysis software program shall have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram of modeled power system, showing the following:
1. Protective device designations and ampere ratings.

2. Conductor types, sizes, and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
6. Derating factors and environmental conditions.
7. Any revisions to electrical equipment required by the study.

D. Comments and recommendations for system improvements or revisions in a written document, separate from one-line diagram.

E. Protective Device Evaluation:
1. Evaluate equipment and protective devices and compare to available short-circuit currents. Verify that equipment withstand ratings exceed available short-circuit current at equipment installation locations.
2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in standards to 1/2-cycle symmetrical fault current.
5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

F. Short-Circuit Study Input Data:
1. One-line diagram of system being studied.
2. Power sources available.
3. Manufacturer, model, and interrupting rating of protective devices.
4. Conductors.
5. Transformer data.

G. Short-Circuit Study Output Reports:
1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
    a. Voltage.
    b. Calculated fault-current magnitude and angle.
    c. Fault-point X/R ratio.
    d. Equivalent impedance.
2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
    a. Voltage.
    b. Calculated symmetrical fault-current magnitude and angle.
    c. Fault-point X/R ratio.
    d. Calculated asymmetrical fault currents:
        1) Based on fault-point X/R ratio.
        2) Based on calculated symmetrical value multiplied by 1.6.
        3) Based on calculated symmetrical value multiplied by 2.7.

3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
   a. Voltage.
   b. Calculated symmetrical fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. No AC Decrement (NACD) ratio.
   e. Equivalent impedance.
   f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
   g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

PART 3 - EXECUTION

3.1 POWER SYSTEM DATA

A. Obtain all data necessary for conduct of the study.
   1. Verify completeness of data supplied on one-line diagram. Call any discrepancies to Architect's attention.
   2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.

B. Gather and tabulate the required input data to support the short-circuit study. Comply with requirements in Section 017839 "Project Record Documents" for recording circuit protective device characteristics. Record data on a Record Document copy of one-line diagram. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:
   1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
   2. Obtain electrical power utility impedance at the service.
   3. Power sources and ties.
   4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
   5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
   6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
   7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
   8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
   9. Motor horsepower and NEMA MG 1 code letter designation.
   10. Conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

11. Derating factors.

3.2 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on device characteristics supplied by device manufacturer.

D. Extent of electrical power system to be studied is indicated on Drawings including contribution from medium voltage system.

E. Begin short-circuit current analysis at the medium voltage service, extending down to system overcurrent protective devices as follows:
   1. To normal system low-voltage load buses where fault current is 10 kA or less.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. Include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for the fault-current dc decrement to address asymmetrical requirements of interrupting equipment.

H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram.
   1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

I. Include in the report identification of any protective device applied outside its capacity.

END OF SECTION 260574

SECTION 260575 - COORDINATION STUDIES

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 computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.

1.3 DEFINITIONS

A. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.

B. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.

D. Power System Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.

E. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.

F. SCCR: Short-circuit current rating.

G. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

H. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS

A. Product Data:

1. For computer software program to be used for studies.
2. Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
    a. Coordination-study input data, including completed computer program input data sheets.
    b. Study and equipment evaluation reports.
3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.
    a. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data:
1. For Power System Analysis Software Developer.
2. For Power Systems Analysis Specialist.
3. For Field Adjusting Agency.

B. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For overcurrent protective devices to include in emergency, operation, and maintenance manuals.
1. The following are from the Coordination Study Report:
    a. Final one-line diagram.
    b. Final protective device coordination study.
    c. Coordination study data files.
    d. List of all protective device settings.
    e. Time-current coordination curves.
    f. Power system data.

1.7 QUALITY ASSURANCE

A. Studies shall be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms shall comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

D. Power System Analysis Software Qualifications:

1. Computer program shall be designed to perform coordination studies or have a function, component, or add-on module designed to perform coordination studies.
2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

E. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

F. Field Adjusting Agency Qualifications:
1. Employer of a NETA ETT-Certified Technician Level III responsible for all field adjusting of the Work.
2. A member company of NETA.
3. Acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CGI CYME.
2. EasyPower, LLC (formerly ESA Inc.).
3. EDSA Micro Corporation.
4. ESA Inc.
5. Operation Technology, Inc.
6. Power Analytics, Corporation.
7. SKM Systems Analysis, Inc.

B. Comply with IEEE 242 and IEEE 399.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
1. Optional Features:
a. Arcing faults.
b. Simultaneous faults.
c. Explicit negative sequence.
d. Mutual coupling in zero sequence.

2.2 COORDINATION STUDY REPORT CONTENTS

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram of modeled power system, showing the following:
   1. Protective device designations and ampere ratings.
   2. Conductor types, sizes, and lengths.
   3. Transformer kilovolt ampere (kVA) and voltage ratings.
   4. Motor and generator designations and kVA ratings.
   5. Switchgear, switchboard, motor-control center, and panelboard designations.
   6. Any revisions to electrical equipment required by the study.
   7. Study Input Data: As described in "Power System Data" Article.
      a. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260574 "Short-Circuit Studies."

D. Protective Device Coordination Study:
   1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.
      a. Phase and Ground Relays:
         1) Device tag.
         2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
         3) Recommendations on improved relaying systems, if applicable.
      b. Circuit Breakers:
         1) Adjustable pickups and time delays (long time, short time, and ground).
         2) Adjustable time-current characteristic.
         3) Adjustable instantaneous pickup.
         4) Recommendations on improved trip systems, if applicable.
      c. Fuses: Show current rating, voltage, and class.

E. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
   1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
   2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
   3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
   4. Plot the following listed characteristic curves, as applicable:
      a. Power utility's overcurrent protective device.
      b. Medium-voltage equipment overcurrent relays.

c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
f. Cables and conductors damage curves.
g. Ground-fault protective devices.
h. Motor-starting characteristics and motor damage points.
i. Generator short-circuit decrement curve and generator damage point.
j. The largest feeder circuit breaker in each motor-control center and panelboard.

5. Maintain selectivity for tripping currents caused by overloads.
6. Maintain maximum achievable selectivity for tripping currents caused by overloads on series-rated devices.
7. Provide adequate time margins between device characteristics such that selective operation is achieved.
8. Comments and recommendations for system improvements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance of the Work. Devices to be coordinated are indicated on Drawings.
1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

A. Obtain all data necessary for conduct of the overcurrent protective device study.
1. Verify completeness of data supplied in one-line diagram on Drawings. Call any discrepancies to Architect's attention.
2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.

B. Gather and tabulate all required input data to support the coordination study. List below is a guide. Comply with recommendations in IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:
1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.

2. Electrical power utility impedance at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus (three phase and line to ground).
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Maximum demands from service meters.
13. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
14. Motor horsepower and NEMA MG 1 code letter designation.
15. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
16. Medium-voltage cable sizes, lengths, conductor material, cable construction, metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).
17. Data sheets to supplement electrical distribution system one-line diagram, cross-referenced with tag numbers on diagram, showing the following:
    a. Special load considerations, including starting inrush currents and frequent starting and stopping.
    b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
    c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
    d. Generator thermal-damage curve.
    e. Ratings, types, and settings of utility company's overcurrent protective devices.
    f. Special overcurrent protective device settings or types stipulated by utility company.
    g. Time-current-characteristic curves of devices indicated to be coordinated.
    h. Manufacturer, frame size, interrupting rating in amperes root mean square (rms) symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
    i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
    j. Switchgear, switchboards, motor-control centers, and panelboards ampacity, and SCCR in amperes rms symmetrical.
    k. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

3.3 COORDINATION STUDY

A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.

B. Comply with IEEE 399 for general study procedures.

C. Base study on device characteristics supplied by device manufacturer.

D. Extent of electrical power system to be studied is indicated on Drawings.

E. Begin analysis at the existing medium voltage service swtich, extending down to system overcurrent protective devices as follows:
   1. To normal system low-voltage load buses where fault current is 10 kA or less.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. Transformer Primary Overcurrent Protective Devices:
   1. Device shall not operate in response to the following:
      a. Inrush current when first energized.
      b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
      c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
   2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

H. Motor Protection:
   1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
   2. Select protection for motors served at voltages more than 600 V according to IEEE 620.

I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

J. Generator Protection: Select protection according to manufacturer's written instructions and to IEEE 242.

K. Include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for fault-current dc decrement, to address asymmetrical requirements of interrupting equipment.

L. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

M. Protective Device Evaluation:
1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
3. Any application of series-rated devices shall be recertified, complying with requirements in NFPA 70.
4. Include in the report identification of any protective device applied outside its capacity.

3.4 MOTOR-STARTING STUDY

A. Perform a motor-starting study to analyze the transient effect of system's voltage profile during motor starting. Calculate significant motor-starting voltage profiles and analyze the effects of motor starting on the power system stability.

B. Prepare the motor-starting study report, noting light flicker for limits proposed by IEEE 141, and, and voltage sags so as not to affect operation of other utilization equipment on system supplying the motor.

3.5 FIELD ADJUSTING

A. Adjust relay and protective device settings according to recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of equipment manufacturer under the "Startup and Acceptance Testing" contract portion.

B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.

C. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification.
1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

3.6 DEMONSTRATION

A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in the following:
1. Acquaint personnel in fundamentals of operating the power system in normal and emergency modes.
2. Hand-out and explain the coordination study objectives, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting time-current coordination curves.

3. For Owner's maintenance staff certified as NETA ETT-Certified Technicians Level III or NICET Electrical Power Testing Level III Technicians, teach how to adjust, operate, and maintain overcurrent protective device settings.

END OF SECTION 260575

SECTION 260800- COMMISSIONING OF LIGHTING CONTROL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes commissioning process requirements for Lighting Control Systems, assemblies, and equipment.

B. Related Sections:

Section 019113 "General Commissioning Requirements" for general commissioning process requirements.

1.3 DEFINITIONS

A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

B. CxA: Commissioning Authority.

C. Lighting Control Systems: Lighting Control Systems, Equipment, Safeties, Interfaces and Interlocks with other systems.

D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates of readiness.

B. Pre-Functional Test Checklist and equipment start up reports.

1.5 CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests and provide reports at the direction of the CxA.

B. Attend construction phase controls coordination meetings.

C. Participate in Lighting Control Systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.

D. Provide information requested by the CxA for final commissioning documentation.

E. Provide measuring instruments and logging devices, calibrated within one year of date of test unless specifications or industry standards require more stringent calibration periods, to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.6 CxA'S RESPONSIBILITIES

A. Provide Project-specific construction checklists and commissioning process test procedures for actual Lighting Control Systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

B. Direct commissioning testing.

C. Organize Contractor provided test data, inspection reports, and certificates in Systems Manual.

1.7 COMMISSIONING DOCUMENTATION

A. Provide the following information to the CxA for inclusion in the commissioning plan:
1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for Lighting Control Systems, assemblies, equipment, and components to be verified and tested.
4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
5. Certificate of readiness certifying that Lighting Control Systems, subsystems, equipment, and associated controls are ready for testing.
6. Test and inspection reports and certificates.
7. Corrective action documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Provide a fully executed Certificate of Readiness signed by Contractor, Subcontractors, and BAS provider certifying that Lighting Control Systems instrumentation and control systems have been completed and calibrated, pre-tested and inspected and that they are operating according to the Contract Documents, and that pretest set points have been recorded. Provide completed Certificate of Readiness to CxA no less than 7 days prior to the scheduled beginning of on-site CxA verification testing.

B. Certify that testing and adjusting procedures have been completed and that testing and adjusting reports have been submitted, discrepancies corrected, and corrective work approved.

C. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

D. Inspect and verify the position of each device and interlock identified on checklists.

E. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

F. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of Lighting Control Systems testing shall include entire Lighting Control Systems installation, from central equipment, lighting control panels, switches, sensors, devices, interfaces and fixtures. Testing shall include measuring capacities and effectiveness of operational and control functions.

C. CxA will witness the test of all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of system controllers and sensors.

D. The specific Electrical Systems Subcontractor shall prepare detailed testing plans, procedures, and checklists for Lighting Control Systems, subsystems, and equipment.

E. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

F. The CxA may direct that set points be altered when simulating conditions is not practical.

G. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

H. If tests cannot be completed because of a deficiency outside the scope of the Lighting Control Systems system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

I. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

END OF SECTION 260800

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.

B. Related Requirements:
   1. Section 262726 "Wiring Devices" for wall-box dimmers and manual light switches.
   2. Section 260800 "Commissioning of Lighting Control Systems" for the commissioning process.

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.
   3. Provide floor plans with devices placed and show coverage of occupancy sensors. Indicate the type used in each room (PIR, Ultrasonic, Dual-Technology).

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.

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Bryant Electric; a Hubbell company.
2. Cooper Industries, Inc.
3. Hubbell Building Automation, Inc.
4. Leviton Mfg. Company Inc.
5. Lightolier Controls.
6. Lithonia Lighting; Acuity Lighting Group, Inc.
7. Lutron Electronics Co., Inc.
8. NSi Industries LLC; TORK Products.
9. RAB Lighting.
10. Sensor Switch, Inc.
11. Square D; a brand of Schneider Electric.
12. Wattstoppe

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 qualified testing agency, 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. Dual contact type shown on the drawings shall be provided with contacts for the lighting and HVAC systems.
4. Power Pack: Dry contacts rated for 20-A LED load at 120- and 277-V acand for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70. Power pack shall be plenum rated.
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.

C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods.
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.

3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.

2.2 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Bryant Electric; a Hubbell company.
2. Cooper Industries, Inc.
3. Hubbell Building Automation, Inc.
4. Leviton Mfg. Company Inc.
5. Lightolier Controls.
6. Lithonia Lighting; Acuity Lighting Group, Inc.
7. Lutron Electronics Co., Inc.
8. NSi Industries LLC; TORK Products.
9. RAB Lighting.
10. Sensor Switch, Inc.
11. Square D; a brand of Schneider Electric.

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 qualified testing agency, 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 LED load at 120 V and 1200-VA LED load at 277 V.
4. Where indicated on the plans, provide dimming capability as part of the device.

2.3 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 22 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

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. Do not install power packs/power supplies in drywall ceilings unless they are near an access panel.

C. 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.

D. Utilize dual technology for all rooms.

3.2 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 nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

E. Coordinate with Division 23 contractor for HVAC occupancy connection.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."
   1. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. 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.

C. Lighting control devices will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, 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.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to 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. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
   1. Distribution transformers.

1.3 ACTION SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

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.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Source quality-control test reports.

C. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.7 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB
2. Eaton.
3. Square D; by Schneider Electric.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.
1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Aluminum.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Cores: One leg per phase.

C. Enclosure: Ventilated, NEMA 250, Type 2.
1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

D. Transformer Enclosure Finish: Comply with NEMA 250.

1. Finish Color: Gray.

E. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

F. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.

G. Energy Efficiency for Transformers Rated 15 kVA and Larger:
1. Complying with NEMA TP 1, Class 1 efficiency levels.
2. Tested according to NEMA TP 2.

H. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

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 C57.12.91.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

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

3.2 INSTALLATION

A. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Section 260529 "Hangers and Supports for Electrical Systems."

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."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
   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. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Remove and replace units that do not pass tests or inspections and retest as specified above.

D. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

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 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. 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.

1.3 DEFINITIONS

A. SVR: Suppressed voltage rating.

B. SPD: Surge protective 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.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field Quality-Control Reports:
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.

C. 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 qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Handle and prepare panelboards for installation according to NEMA PB 1.

1.9 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.

1.10 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 Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Enclosures: Flush- and surface-mounted cabinets.
   1. Rated for environmental conditions at installed location.
      a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
      b. Outdoor Locations: NEMA 250, Type 3R.
   2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
   3. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
   4. 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.
   5. Directory Card: Inside panelboard door, mounted in transparent card holder.

B. Incoming Mains Location: Top or bottom as required.

C. Phase, Neutral, and Ground Buses:
   1. Material: Tin-plated aluminum.
   2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

D. 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.

E. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

F. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB
2. Eaton.
3. Square D; by Schneider Electric.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

D. Mains: Circuit breaker and Lugs only.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB
2. Eaton.
3. Square D; by Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: As indicated on panel schedules.

D. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB
2. Eaton.
3. Square D; by Schneider Electric.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
   a. Standard frame sizes, trip ratings, and number of poles.
   b. Lugs: compression style, suitable for number, size, trip ratings, and conductor materials.

3. Electronic Trip Circuit Breakers (For NEC Article 700 Life Safety Main Breaker):
   a. RMS sensing.
   b. Field-replaceable rating plug or electronic trip.
   c. Digital display of settings, trip targets, and indicated metering displays.
   d. Multi-button keypad to access programmable functions and monitored data.
   e. Ten-event, trip-history log. Each trip event must be recorded with type, phase, and magnitude of fault that caused trip.
   f. Integral test jack for connection to portable test set or laptop computer.
   g. Field-Adjustable Settings:
      1) Instantaneous trip.
      2) Long- and short-time pickup levels.
      3) Long and short time adjustments.
      4) Ground-fault pickup level, time delay, and I squared T response.

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. Mount top of trim 90 inches above finished floor unless otherwise indicated.

C. 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.

D. Install filler plates in unused spaces.

E. 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.

F. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

G. 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 after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in 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.

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.

END OF SECTION 262416

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. USB charger devices.
   3. Twist-locking receptacles.
   4. Snap switches and wall-box dimmers.
   5. Floor box and Poke-through assemblies.
   6. Cord reel receptacles

B. Related Requirements:
   1. Section 260800 "Commissioning of Lighting Control Systems" for the commissioning process for lighting controls.

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. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 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.

1.7 Coordination

A. Ensure compatibility between lighting fixtures and fixture controls.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
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 qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

A. 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. Products: Subject to compliance with requirements, provide one the following:

a. Cooper; 5351 (single), CR5362 (duplex).
b. Hubbell; HBL5351 (single), HBL5352 (duplex).
c. Leviton; 5891 (single), 5352 (duplex).
d. Pass & Seymour; 5361 (single), 5362 (duplex).

B. Tamper-Resistant Duplex Receptacles, 125 V, 20 A
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
b. Leviton Manufacturing Co., Inc.
c. Pass & Seymour; Legrand North America, LLC.
d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498 and FS W-C-596.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

2.4 GFCI RECEPTACLES

A. General Description:
1. Straight blade, non-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.
4. Exterior GFCI receptacles shall be weather-resistant type.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Cooper; VGF20.
b. Hubbell; GFR5352L.
c. Pass & Seymour; 2095.
d. Leviton; 7590.

C. Weather-Resistant Duplex Receptacle, 125 V, 20 A :
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
b. Leviton Manufacturing Co., Inc.
c. Pass & Seymour; Legrand North America, LLC.
d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498.
5. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.

2.5 USB CHARGER DEVICES

A. Tamper-Resistant, USB Charger with duplex receptacles: comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 1310, and FS W-C-596.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Eaton (Arrow Hart).
      b. Hubbell Incorporated; Wiring Device-Kellems.
      c. Leviton Manufacturing Co., Inc.
      d. Pass & Seymour/Legrand (Pass & Seymour).
   2. USB Receptacles: Double, Type C, 60 Watt.

2.6 TWIST-LOCKING RECEPTACLES

A. See drawings for all configuration types and coordinate with owner provided equipment.

B. Twist-Lock, 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, provide products by one of the following:
      a. Eaton (Arrow Hart).
      b. Hubbell Incorporated; Wiring Device-Kellems.
      c. Leviton Manufacturing Co., Inc.
      d. Pass & Seymour/Legrand (Pass & Seymour).
   2. Grounding: 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.
   3. See drawings for more NEMA configurations.

2.7 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, provide one of 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.

2. Products shall be compatible with LED lighting fixtures and associated occupancy sensor.

C. Pilot-Light Switches: 120/277 V, 20 A.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).
2. Description: Single pole, with LED-lighted handle, illuminated when switch is off.

2.8 WALL-BOX DIMMERS

A. Control: Continuously adjustable slider separate from the on/off switch; with single-pole or three-way switching. Comply with UL 1472.

B. LED 0-10 Volt Dimmer Switches: Modular; compatible with drivers; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 10 percent of full brightness.

2.9 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: thermoplastic.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, while in use type, weather-resistant, die-cast aluminum with lockable cover.

2.10 FLOOR SERVICE ASSEMBLIES

A. Type: Modular, flush-type, dual-service units suitable for wiring method used. Basis of Design Legrand RFB4E with flush style cover in manufacturer's standard finish with (2) duplex receptacles.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Pass & Seymour/Legrand.
3. Square D/Schneider Electric.
4. Thomas & Betts Corporation.
5. Wiremold/Legrand.

2.11 POKE-THROUGH ASSEMBLIES

A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.

B. Basis of design for power only poke-thru is Legrand Evolution 8AT series with flush style cover assembly with two slide egress doors.

C. Basis of design for power, AV and telecom poke-thru is Legrand Evolution Series 8" poke thru with flush style cover assembly with two slide egress doors. Poke-thru shall accommodate conduit sizes listed on the plans.

D. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Hubbell Incorporated; Wiring Device-Kellems.
2. Pass & Seymour/Legrand.
3. Square D/Schneider Electric.
4. Thomas & Betts Corporation.
5. Wiremold/Legrand.

E. Description:
1. Type: Modular, flush-type, dual-service units suitable for wiring method used. See drawings for types.
2. Compartments: Barrier separates power from voice and data communication cabling.
   a. Standards: Comply with scrub water exclusion requirements in UL 514.
   b. Size: Selected to fit nominal 8 cored holes in floor and matched to floor thickness.
   c. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
   d. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, four-pair CAT cables and rough-in for AV as stated on the dwgs. Power only type poke-thru's shall accommodate two duplex receptacles.
   e. Metal cover with spring loaded slide egress doors in manufacturer's standard finish.

2.12 CORD REEL RECEPTACLES

A. Provide a heavy duty, light industrial, retractable cord reel with 25' long, 20 Amp, 12/3 SOOW cord with NEMA 5-20R quad receptacle box.

B. Product shall be similar to the Legrand CRCD 1000 series with 25' length.

2.13 FINISHES

A. Device Color:
1. Wiring Devices Connected to Normal Power System: White.

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.

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 down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:
1. Install dimmers within terms of their listing.
2. 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 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. For common spaces (not units) Identify each receptacle with panelboard identification and circuit number.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
1. Test Instruments: Use instruments that comply with UL 1436.
2. 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 262813 - FUSES

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. Cartridge fuses rated 600-V ac and less for use in enclosed switches and enclosed controllers.
   2. Plug fuses rated 125-V ac and less for use in plug-fuse-type enclosed switches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
   1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
      a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
      b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
   2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
   3. Current-limitation curves for fuses with current-limiting characteristics.
   4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
   5. Coordination charts and tables and related data.
   6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
   1. Ambient temperature adjustment information.
   2. Current-limitation curves for fuses with current-limiting characteristics.
   3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.

4. Coordination charts and tables and related data.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.
3. Ferraz Shawmut, Inc.
4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.3 PLUG FUSES

A. Characteristics: UL 248-11, nonrenewable plug fuses; 125-V ac.

2.4 PLUG-FUSE ADAPTERS

A. Characteristics: Adapters for using Type S, rejection-base plug fuses in Edison-base fuseholders or sockets; ampere ratings matching fuse ratings; irremovable once installed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

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

3.2 FUSE APPLICATIONS

1. Motor Branch Circuits: Class RK1, time delay.
2. Control Circuits: Class CC, fast acting.

B. Plug Fuses:

1. Motor Branch Circuits: Edison-base type, dual-element time delay.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install plug-fuse adapters in Edison-base fuseholders and sockets. Ensure that adapters are irremovable once installed.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Fusible switches.
   2. Nonfusible switches.
   3. Molded-case circuit breakers (MCCBs).
   4. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
   1. Enclosure types and details for types other than NEMA 250, Type 1.
   2. Current and voltage ratings.
   3. Short-circuit current ratings (interrupting and withstand, as appropriate).
   4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
   5. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
   1. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. 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.

C. Manufacturer's field service report.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers 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 enclosed switches and circuit breakers.
   2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.
   1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NFPA 70.

1.8 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB
2. Eaton.
3. Square D; by Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 240 and 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB
2. Eaton.
3. Square D; by Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 240 and 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB
2. Eaton.

3. Square D; by Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Features and Accessories:
1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

2.4 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Install fuses in fusible devices.

C. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each enclosure with engraved metal or laminated-plastic nameplate.

B. Provide placard for emergency stop pushbutton that says "emergency stop". Placard shall be 4" x 4" minimum and be placed directly above emergency pushbutton.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
   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 enclosed switch and circuit breaker, 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. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262816

SECTION 262913 - MANUAL AND MAGNETIC MOTOR CONTROLLERS

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 the following enclosed controllers rated 600 V and less:
   1. Full-voltage manual.
   2. Full-voltage magnetic.

1.3 DEFINITIONS

A. CPT: Control power transformer.

B. MCCB: Molded-case circuit breaker.

C. MCP: Motor circuit protector.

D. N.C.: Normally closed.

E. N.O.: Normally open.

F. OCPD: Overcurrent protective device.

G. SCR: Silicon-controlled rectifier.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.

B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
   1. Show tabulations of the following:
      a. Each installed unit's type and details.
      b. Factory-installed devices.
      c. Nameplate legends.
      d. Short-circuit current rating of integrated unit.

e. Listed and labeled for integrated short-circuit current (withstand) rating of OCPDs in combination controllers by an NRTL acceptable to authorities having jurisdiction.
f. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.

2. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
1. Routine maintenance requirements for enclosed controllers and installed components.
2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
3. Manufacturer's written instructions for setting field-adjustable overload relays.
4. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage solid-state controllers.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.
1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

D. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers;.

1.9 COORDINATION

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.

B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Eaton.
   b. General Electric Company.
   c. Rockwell Automation, Inc.
   d. Square D; by Schneider Electric.
2. Configuration: Nonreversing.
3. Surface mounting.
4. Red pilot light.

C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Eaton.
   b. General Electric Company.
   c. Rockwell Automation, Inc.
   d. Square D; by Schneider Electric.
2. Configuration: Nonreversing.
3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
4. Surface mounting.
5. Red pilot light.

D. Integral Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Eaton.
   b. General Electric Company.

c. Rockwell Automation, Inc.
d. Square D; by Schneider Electric.

2. Configuration: Nonreversing.
3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters and sensors in each phase, matched to nameplate full-load current of actual protected motor and having appropriate adjustment for duty cycle; external reset push button; bimetallic type.
4. Surface mounting.
5. Red pilot light.

E. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Eaton.
b. General Electric Company.
c. Rockwell Automation, Inc.
d. Square D; by Schneider Electric.
2. Fusible Disconnecting Means:
a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class J fuses.
b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
3. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
4. MCP Disconnecting Means:
a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
d. N.C. or N.O. alarm contact that operates only when MCP has tripped.
e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.

2.2 ENCLOSURES

A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
1. Dry and Clean Indoor Locations: Type 1.
2. Outdoor Locations: Type 3R.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.

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

3.2 INSTALLATION

A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in each fusible-switch enclosed controller.

D. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813 "Fuses."

E. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

F. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each enclosure with engraved nameplate.
   3. Label each enclosure-mounted control and pilot device.

3.4 CONTROL WIRING INSTALLATION

A. Bundle, train, and support wiring in enclosures.

B. Connect selector switches and other automatic-control selection devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. 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.

D. Acceptance Testing Preparation:
1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:
1. Inspect controllers, wiring, components, connections, and equipment installation.
2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Construction Manager before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed controllers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.

C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Construction Manager before increasing settings.

3.7 PROTECTION

A. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION 262913

SECTION 264113 - LIGHTNING PROTECTION FOR STRUCTURES

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 lightning protection system for ordinary structures.

B. Product Data: For each type of product.

C. Shop Drawings:
1. Include layouts of the lightning protection system, with details of the components to be used in the installation.
2. Include raceway locations needed for the installation of conductors.
3. Details of air terminals, ground rods, ground rings, conductor supports, splices, and terminations, including concealment requirements.
4. Include roof attachment details, coordinated with roof installation.
5. Calculations required by NFPA 780 for bonding of metal bodies.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Lightning protection system Shop Drawings, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Lightning protection cabling attachments to roofing systems and accessories.
2. Lightning protection strike termination device attachment to roofing systems, coordinated with the roofing system manufacturer.
3. Lightning protection system components penetrating roofing and moisture protection systems and system components, coordinated with the roofing system manufacturer.

B. Qualification Data: For Installer.

C. Product Certificates: For each type of roof adhesive for attaching the roof-mounted air terminal assemblies, approved by the roofing-material manufacturer.

D. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For lightning protection system to include in maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      a. Dimensioned site plan showing dimensioned route of the ground loop conductor and the ground rod locations. Comply with requirements of Section 017839 "Project Record Documents."
      b. A system testing and inspection record, listing the results of inspections and ground resistance tests, as recommended by NFPA 780, Annex D.

B. Completion Certificate:
   1. UL Master Label Certificate.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: UL-listed installer, category OWAY.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ERICO; brand of nVent Electrical plc.
   2. East Coast Lightning Equipment Inc.
   3. Harger Lightning & Grounding; business of Harger, Inc.
   4. Heary Bros. Lightning Protection Co. Inc.
   5. Independent Protection Co.
   6. National Lightning Protection.
   7. Preferred Lightning Protection.
   8. Robbins Lightning, Inc.
   9. Thompson Lightning Protection, Inc.
   10. allG Fabrication (formerly ALT).

2.2 PERFORMANCE REQUIREMENTS

A. NFPA Lightning Protection Standard: Comply with NFPA 780 requirements for Class I buildings.

B. Lightning Protection Components, Devices, and Accessories: Listed and labeled by a qualified testing agency as complying with UL 96, and marked for intended location and application.

2.3 MATERIALS

A. Air Terminals:

1. Aluminum unless otherwise indicated.
2. 3/8-inch diameter by 10 inches long.
3. Rounded tip.
4. Integral base support.

B. Class II Main Conductors:
1. Aluminum: 192,000 circular mils in diameter.

C. Secondary Conductors:
1. Aluminum: 41,400 circular mils in diameter.

D. Ground Loop Conductor: Stranded copper**.**

E. Ground Rods:
1. Material: Copper-clad steel.
2. Diameter: 3/4 inch.
3. Rods shall be not less than 120 inches long.

F. Conductor Splices and Connectors: Compression fittings that are installed with hydraulically operated tools, or exothermic welds, approved for use with the class type.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lightning protection components and systems according to NFPA 780 for a Class II system.

B. Install conductors with direct paths from air terminals to ground connections. Avoid bends less than 90 degrees and 8 inches in radius and narrow loops.

C. Conceal conductors within normal view from exterior locations at grade within 200 feet of building. Comply with requirements for concealed systems in NFPA 780.
1. Roof penetrations required for down conductors and connections to structural-steel framework shall be made using listed through-roof fitting and connector assemblies with solid rods and appropriate roof flashings. Use materials approved by the roofing manufacturer for the purpose. Conform to the methods and materials required at roofing penetrations of the lightning protection components to ensure compatibility with the roofing specifications and warranty.
2. Install conduit where necessary to comply with conductor concealment requirements.
3. Air Terminals on Single-Ply Membrane Roofing: Comply with adhesive manufacturer's written instructions.

D. Ground Ring Electrode: The conductor shall be not less than the main-size lightning conductor.

3.2 CONNECTIONS

A. Aboveground concealed connections, and connections in earth or concrete, shall be done by exothermic welds or by high-compression fittings listed for the purpose.

B. Aboveground exposed connections shall be done using the following types of connectors, listed and labeled for the purpose: exothermic weld.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

3.3 CORROSION PROTECTION

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

B. Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
   1. Perform inspections as required to obtain a UL Master Label for system.

B. Prepare test and inspection reports and certificates.

END OF SECTION 264113

SECTION 264313 - SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

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 field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

B. Factory-installed SPD devices in panels and switchboards are not allowed. All units shall be field mounted and wired to branch circuit breaker in panel or switchboard the device is protecting.

1.3 DEFINITIONS

A. Inominal: Nominal discharge current.

B. MCOV: Maximum continuous operating voltage.

C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.

D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.

E. OCPD: Overcurrent protective device.

F. SCCR: Short-circuit current rating.

G. SPD: Surge protective device.

H. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For SPDs to include in maintenance manuals.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL SPD REQUIREMENTS

A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Comply with UL 1449.

D. MCOV of the SPD shall be the nominal system voltage.

2.2 SERVICE ENTRANCE SUPPRESSOR

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. ABB, Electrification Business.
2. Advanced Protection Technologies Inc. (APT).
3. DITEK Surge Protection.
4. Eaton.
5. Schneider Electric USA, Inc.

B. SPDs: Comply with UL 1449, Type 2.

1. SPDs with the following features and accessories:
   a. Integral disconnect switch.
   b. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
   c. Indicator light display for protection status.
   d. Form-C contacts rated at 5A and 250-Vac, one normally open and one normally closed, for remote monitoring of protection status.
   e. Surge counter.

C. Comply with UL 1283.

D. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 320 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

E. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits shall not exceed the following:
   1. Line to Neutral: 1200 V for 480Y/277 V. 700 V for 208Y/120 V
   2. Line to Ground: 1200 V for 480Y/277 V. 700 V for 208Y/120 V
   3. Line to Line: 2000 V for 480Y/277 V. 1200 V for 208/120 V

F. SCCR: Equal or exceed 100 kA.

G. Inominal Rating: 20 kA.

2.3 ENCLOSURES

A. Indoor Enclosures: NEMA 250, Type 1.

2.4 CONDUCTORS AND CABLES

A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.

C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

D. Use crimped connectors and splices only. Wire nuts are unacceptable.

E. Wiring:
   1. Power Wiring: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.
   1. Compare equipment nameplate data for compliance with Drawings and Specifications.
   2. Inspect anchorage, alignment, grounding, and clearances.
   3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. An SPD will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Complete startup checks according to manufacturer's written instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION 264313

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. Miscellaneous LED luminaires
2. Materials.
3. Luminaire support.

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.
    a. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

B. Shop Drawings: For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing laboratory providing photometric data for luminaires.

B. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Product Certificates: For each type of luminaire.

D. Product Test Reports: For each type of luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.

E. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications:
1. Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
2. Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited

under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

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 Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Ambient Temperature: 41 to 104 deg F.
1. Relative Humidity: Zero to 95 percent.

B. Altitude: Sea level to 1000 feet.

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. LED Fixtures: Comply with UL 8750. Heat sink cooling without fans, pumps or moving parts.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

F. Diffusers and Globes:
1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
   a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
   b. UV stabilized.
2. Glass: Annealed crystal glass unless otherwise indicated.

G. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
1. Label shall include the following lamp characteristics:
   a. "USE ONLY" and include specific lamp type.
   b. Lamp diameter, shape, size, wattage, and coating.
   c. CCT and CRI.

H. Recessed luminaires shall comply with NEMA LE 4.

2.4 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide product indicated on Drawings or prior approved equal.

2.5 DRIVERS/POWER SUPPLYS FOR LED

A. Description: Self-contained power supply that has outputs matched to the electrical characteristics of the LED or array of LEDs.
1. Driver compartment meets or exceeds IEC standard IP54.
2. Located inside the housing with serviceable access for replacement.
3. Housing or lenses constructed of polymers; must be UV stabilized.
4. Must be current-regulated (deliver a consistent current over a range of load voltages.
5. Designed for multi-current input operation.
6. Must operate between -20°C and 50°C.
7. Sound Rating: Class A.
8. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
9. Operating Frequency: 120 Hz or higher.
10. Power Factor: 0.90 or higher.
11. Dimming capability shall be fade to 10%.

2.6 LEDs

A. LED Module/Array: Designed for multi-current input operation.

B. Light Quality: CRI 65 (minimum), color temperature 3500 K unless otherwise noted on drawings.

C. Minimum Lamp Life: L70 at 50,000 hours average rated life.

2.7 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. Steel:
1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for sheet steel.

C. Stainless Steel:
1. Manufacturer's standard grade.
2. Manufacturer's standard type, ASTM A240/240M.

D. Galvanized Steel: ASTM A653/A653M.

E. Aluminum: ASTM B209.

2.8 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.

2.9 LUMINAIRE SUPPORT

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 A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage.

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 luminaire installation.

C. 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 a vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaires:
1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaires:
1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

G. Suspended Luminaires:
1. Ceiling Mount:
a. Two 5/32-inch- diameter aircraft cable supports adjustable to 10 feet in length.

b. Pendant mount with 5/32-inch- diameter aircraft cable supports adjustable to 10 feet in length.
c. Hook mount.

2. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
3. 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.
4. 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.
5. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

H. Ceiling-Grid-Mounted Luminaires:
1. Secure to any required outlet box.
2. 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.

I. 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."

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 265119

SECTION 265213 - EMERGENCY AND EXIT 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. Emergency lighting.
   2. Exit signs.
   3. Materials.
   4. Luminaire support components.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire" Paragraph.

D. Lumen: Measured output of lamp and luminaire, or both.

E. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.
   1. Include data on features, accessories, and finishes.
   2. Include physical description of the unit and dimensions.
   3. Battery and charger for light units.
   4. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
   5. Include photometric data and adjustment factors based on laboratory tests, complying with IES LM-45, for each luminaire type.
      a. Testing Agency Certified Data: For indicated luminaires and signs, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires and signs shall be certified by manufacturer.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Product Schedule:
1. For emergency lighting units. Use same designations indicated on Drawings.
2. For exit signs. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of luminaire.

B. Product Test Reports: For each luminaire for tests performed by manufacturer and witnessed by a qualified testing agency.

C. Sample Warranty: For manufacturer's warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in emergency, 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: Independent NRTL that is accredited under National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products and complying with applicable IES testing standards.

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.
1. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.

C. Comply with NFPA 70 and International Building Codes (IBC and IFC).

D. Comply with NEMA LE 4 for recessed luminaires.

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. Operating at nominal voltage of 277 V ac.
2. Lamps for AC Operation:
    a. LEDs; 50,000 hours minimum rated lamp life.

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:
1. Smooth operating, free of light leakage under operating conditions.
2. Designed to permit relamping without use of tools.
3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

2.4 METAL FINISHES

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Support Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.

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

3.2 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:
1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position when testing emergency power unit.
3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.

E. Wall-Mounted Luminaire Support:
1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

F. Suspended Luminaire Support:
1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.

2. Stem-Mounted, Single-Unit 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.

G. Ceiling Grid Mounted Luminaires:
1. Secure to any required outlet box.
2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
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.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
1. Test for Emergency Lighting: Interrupt normal power supply to demonstrate proper operation. Verify transfer from normal power to emergency power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 265213

SECTION 265619 - LED EXTERIOR 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. Luminaire types.
2. Materials.
3. Finishes.
4. Luminaire support components.

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.
2. Section 260943.23 "Relay-Based Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.

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. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.
1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaire.

4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
5. Wiring diagrams for power, control, and signal wiring.
6. Photoelectric relays.
7. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

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.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Luminaires.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Product Certificates: For each type of the following:
1. Luminaire.
2. Photoelectric relay.

D. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.

E. Source quality-control reports.

F. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and photoelectric relays to include in operation and maintenance manuals.
1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications:
1. Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
2. Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited

under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.

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.

D. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.9 FIELD CONDITIONS

A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.

B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures, including luminaire support components.
      b. Faulty operation of luminaires and accessories.
      c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   2. Warranty Period: 2 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: Comply with UL 1598 and listed for wet location.

C. Lamps dimmable from 100 percent to 0 percent of maximum light output.

D. Internal driver.

E. Nominal Operating Voltage: 277 V ac.

F. Lamp Rating: Lamp marked for outdoor use and in enclosed locations.

G. Source Limitations:
1. Obtain luminaires from single source from a single manufacturer.
2. For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.

B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay.
1. Relay with locking-type receptacle shall comply with ANSI C136.10.
2. Adjustable window slide for adjusting on-off set points.

2.3 LUMINAIRE TYPES

A. See lighting fixture schedule.

2.4 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Corrosion-resistant aluminum or epoxy-coated steel. Form and support to prevent warping and sagging.

C. 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. Doors shall be removable for cleaning or replacing lenses.

D. Diffusers and Globes:
1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
   1. White Surfaces: 85 percent.
   2. Specular Surfaces: 83 percent.
   3. Diffusing Specular Surfaces: 75 percent.

G. Housings:
   1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
   2. Provide filter/breather for enclosed luminaires.

H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
   1. Label shall include the following lamp characteristics:
      a. "USE ONLY" and include specific lamp type.
      b. Lamp diameter, shape, size, wattage and coating.
      c. CCT and CRI for all luminaires.

2.5 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
   1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

D. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
   1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
   2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
      a. Color:
         1) As selected from manufacturer's standard catalog of colors.
         2) Match Architect's sample of manufacturer's standard color.
         3) As selected by Architect from manufacturer's full range.

2.6 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 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 electrical conduit to verify actual locations of conduit connections before luminaire installation.

C. Examine walls, roofs, and canopy ceilings and overhang ceilings for suitable conditions where luminaires will be installed.

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

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Install lamps in each luminaire.

D. Fasten luminaire to structural support.

E. Supports:
1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Support luminaires without causing deflection of finished surface.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

F. Wall-Mounted Luminaire Support:
1. Attached to structural members in walls.

G. Wiring Method: Install cables in raceways. Conceal raceways and cables.

H. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.

I. Coordinate layout and installation of luminaires with other construction.

J. Adjust luminaires that require field adjustment or aiming.

K. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.3 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

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. Verify operation of photoelectric controls.

C. Luminaire will be considered defective if it does not pass tests and inspections.

D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

END OF SECTION 265619

SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Grounding conductors.
2. Grounding connectors.
3. Grounding busbars.
4. Grounding labeling.

1.3 DEFINITIONS

A. BCT: Bonding conductor for telecommunications.

B. TGB: Telecommunications grounding busbar.

C. TMGB: Telecommunications main grounding busbar.

D. Service Provider: The operator of a service that provides telecommunications transmission delivered over access provider facilities.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For communications equipment room signal reference grid. Include plans, elevations, sections, details, and attachments to other work.

1.5 INFORMATIONAL SUBMITTALS

A. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:
1. Ground rods.
2. Ground and roof rings.
3. BCT, TMGB, TGBs, and routing of their bonding conductors.

B. Qualification Data: For testing agency and testing agency's field supervisor.

C. Field quality-control reports.

1.6 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. Result of the ground-resistance test, measured at the point of BCT connection.
b. Result of the bonding-resistance test at each TGB and its nearest grounding electrode.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

C. Comply with TIA-607-B.

2.2 CONDUCTORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Harger Lightning & Grounding.
2. Panduit Corp.
3. TE Connectivity Ltd.

B. Comply with UL 486A-486B.

C. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
2. Cable Tray Equipment Grounding Wire: No. 8 AWG.

D. Cable Tray Grounding Jumper:
1. Not smaller than No. 10 AWG and not longer than 12 inches. If jumper is a wire, it shall have a crimped grounding lug with one hole and standard barrel for one crimp. If jumper is a flexible braid, it shall have a one- or two-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.

E. Bare Copper Conductors:
1. Solid Conductors: ASTM B3.
2. Stranded Conductors: ASTM B8.
3. Tinned Conductors: ASTM B33.
4. Bonding Cable: 28 kcmils, 14 strands of No. 17 AWG conductor, and 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.3 CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Chatsworth Products, Inc.
2. Harger Lightning & Grounding.
3. Hubbell Incorporated (Burndy).
4. Panduit Corp.
5. TE Connectivity Ltd.

B. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.

C. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.
1. Electroplated tinned copper, C and H shaped.

D. Signal Reference Grid Connectors: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.

E. Busbar Connectors: Cast silicon bronze, solderless compression-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch centers for a two-bolt connection to the busbar.

F. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING BUSBARS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Chatsworth Products, Inc.
2. Harger Lightning & Grounding.
3. Panduit Corp.

B. TMGB in MDF: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches in cross section, 24" in length. The busbar shall be NRTL listed for use as TMGB and shall comply with TIA-607-B.
   1. Predrilling shall be with holes for use with lugs specified in this Section.
   2. Mounting Hardware: Stand-off brackets that provide a 4-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
   3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

C. TGB for IDF Rooms: Predrilled rectangular bars of hard-drawn solid copper, 1/4 by 2 inches in cross section, 12" length. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with TIA-607-B.
   1. Predrilling shall be with holes for use with lugs specified in this Section.
   2. Mounting Hardware: Stand-off brackets that provide at least a 2-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
   3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

2.5 IDENTIFICATION

A. Comply with requirements for identification products in Section 270553 "Identification for Communications Systems."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.

B. Inspect the test results of the ac grounding system measured at the point of BCT connection.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.

B. Comply with NECA 1.

C. Comply with TIA-607-B.

3.3 APPLICATION

A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
   1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
   2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.

C. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
   3. Connections to Ground Rods at Test Wells: Bolted connectors.
   4. Connections to Structural Steel: Welded connectors.

D. Conductor Support:
   1. Secure grounding and bonding conductors at intervals of not less than 36 inches.

E. Grounding and Bonding Conductors:
   1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
   2. Install without splices.
   3. Support at not more than 36-inch intervals.
   4. Install grounding and bonding conductors in 3/4-inch PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
      a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 270528 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

3.4 GROUNDING ELECTRODE SYSTEM

A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than No. 2/0 AWG.

3.5 GROUNDING BUSBARS

A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches minimum from wall, 12 inches above finished floor unless otherwise indicated.

B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.6 CONNECTIONS

A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.

B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.

C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
   1. Use crimping tool and the die specific to the connector.
   2. Pretwist the conductor.
   3. Apply an antioxidant compound to all bolted and compression connections.

D. Primary Protector: Bond to the TMGB with insulated bonding conductor.

E. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than 2 kcmils/linear foot of conductor length, up to a maximum size of No. 3/0 AWG unless otherwise indicated.

F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install top-mounted rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB No. 2 AWG bonding conductors.

G. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.

H. Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA-568-C.1 and TIA-568-C.2 when grounding shielded balanced twisted-pair cables.

I. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.

3.7 IDENTIFICATION

A. Labels shall be preprinted or computer-printed type.
   1. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.
   2. Label TGB(s) with "fs-TGB," where "fs" is the telecommunications space identifier for the space containing the TGB.
   3. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:
   1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
   2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
      a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.
   3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.
      a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB and in each TGB. Maximum acceptable ac current level is 1 A.

D. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.

E. Grounding system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 270526

SECTION 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Metal conduits and fittings.
   2. Hooks.
   3. Boxes, enclosures, and cabinets.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid conduit.

C. IMC: Intermediate metal conduit.

D. RTRC: Reinforced thermosetting resin conduit.

1.4 ACTION SUBMITTALS

A. Product data for the following:
   1. Boxes, enclosures, and cabinets.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Allied Tube & Conduit; a part of Atkore International.
   2. Republic Conduit.
   3. Southwire Company.
   4. Thomas & Betts Corporation; A Member of the ABB Group.
   5. Western Tube and Conduit Corporation.
   6. Wheatland Tube Company.

C. General Requirements for Metal Conduits and Fittings:
   1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
   2. Comply with TIA-569-D.

D. GRC: Comply with ANSI C80.1 and UL 6.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. EMT: Comply with ANSI C80.3 and UL 797.

G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
   1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
   2. Fittings for EMT:
      a. Material: Steel.
      b. Type: compression.
   3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.

H. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 HOOKS

A. Description: Prefabricated sheet metal cable supports for telecommunications cable.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. MonoSystems, Inc.
   2. Panduit Corp.
   3. Wiremold / Legrand.

C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with TIA-569-D.

E. Galvanized steel.

F. J shape, sized to hold a maximum of 50 cables.

2.3 BOXES, ENCLOSURES, AND CABINETS

A. Description: Enclosures for communications.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carlon; a brand of Thomas & Betts Corporation.
2. FSR Inc.
3. Hoffman; a brand of nVent.
4. Hubbell Incorporated (Commercial and Industrial Group - RACO).
5. Hubbell Incorporated (Power Systems Group - Quazite).
6. Thomas & Betts Corporation; A Member of the ABB Group.
7. Wiremold / Legrand.

C. General Requirements for Boxes, Enclosures, and Cabinets:
1. Comply with TIA-569-D.
2. Boxes, enclosures, and cabinets installed in wet locations shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for use in wet locations.
3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
4. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
5. Gangable boxes are prohibited.

D. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. 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.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

A. Indoors: Apply pathway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Concealed in Ceilings and Interior Walls and Partitions: JHooks to cabletray.
4. Damp or Wet Locations: IMC.
5. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: EMT
6. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: EMT.

7. Boxes and Enclosures: NEMA 250, Type 1.

B. Minimum Pathway Size: 1-inch trade size for copper and aluminum cables, and 2 inch for optical-fiber cables.

C. Pathway Fittings: Compatible with pathways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.

D. Install surface pathways only where indicated on Drawings.

E. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Before installation of any boxes or conduit, contractor shall meet with Owner's wiring installer to coordinate rough-ins for typical spaces.

B. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:
1. NECA 1.
2. NECA/BICSI 568.
3. TIA-569-D.
4. NECA 101
5. NECA 105.

C. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

D. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

E. Comply with requirements in Section 270529 "Hangers and Supports for Communications Systems" for hangers and supports.

F. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling" for sleeves and sleeve seals for communications.

G. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

H. Complete pathway installation before starting conductor installation.

I. Arrange stub-ups so curved portions of bends are not visible above finished slab.

J. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.

K. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

L. Support conduit within 12 inches of enclosures to which attached.

M. Stub-ups to Above Recessed Ceilings:
1. Use EMT, IMC, or RMC for pathways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.

O. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.

P. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.

Q. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus one additional quarter-turn.

R. 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.

S. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

T. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.

U. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
1. 3/4-Inch Trade Size and Smaller: Install pathways in maximum lengths of 50 feet.
2. 1-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet.
3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

V. Install pathway-sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway-sealing fittings according to NFPA 70.

W. Install devices to seal pathway interiors at accessible locations. Locate seals, so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service pathway enters a building or structure.
3. Where otherwise required by NFPA 70.

X. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

Y. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT that is located where environmental temperature change may exceed 100 deg F, and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
   a. Attics: 135 deg F temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

Z. Hooks:
1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.
2. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.
3. Hook spacing shall allow no more than 6 inches of slack. The lowest point of the cables shall be no less than 6 inches adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.
4. Space hooks no more than 2 feet o.c.
5. Provide a hook at each change in direction.

AA. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

BB. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

CC. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.

DD. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

EE. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

FF. Set metal floor boxes level and flush with finished floor surface.

GG. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.4 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 PROTECTION

A. Protect coatings, finishes, and cabinets from damage or deterioration.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 270528

SECTION 270529 - HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Requirements:
   1. Section 270548 "Seismic Controls for Communications Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.2 SUMMARY

A. Section Includes:
   1. Steel slotted support systems for communication raceways.
   2. Aluminum slotted support systems for communication raceways.
   3. Conduit and cable support devices.
   4. Support for conductors in vertical conduit.
   5. Structural steel for fabricated supports and restraints.
   6. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
   7. Fabricated metal equipment support assemblies.

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 the following:
      a. Slotted support systems, hardware, and accessories.
      b. Clamps.
      c. Hangers.
      d. Sockets.
      e. Eye nuts.
      f. Fasteners.
      g. Anchors.
      h. Saddles.
      i. Brackets.
   2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. For fabrication and installation details for communications hangers and support systems.
   1. Trapeze hangers. Include product data for components.

2. Steel slotted-channel systems.
3. Aluminum slotted-channel systems.
4. Equipment supports.
5. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Seismic Qualification Data: Certificates, for hangers and supports for communications equipment and systems, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Delegated-Design Submittal: For hangers and supports for communications systems.
1. Include design calculations and details of trapeze hangers.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M.
2. AWS D1.2/D1.2M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hanger and support system.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Allied Tube & Conduit; a part of Atkore International.
b. B-line, an Eaton business.
c. CADDY; a brand of nVent.
d. Flex-Strut Inc.
e. Thomas & Betts Corporation; A Member of the ABB Group.
f. Unistrut; Part of Atkore International.

2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Material for Channel, Fittings, and Accessories: Galvanized steel.
4. Channel Width: Selected for applicable load criteria.
5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
8. Channel Dimensions: Selected for applicable load criteria.

B. Conduit and Cable Support Devices: Steel clamps, hangers, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored communications conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
2. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M,Grade A325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.3 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 the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
   1. NECA 1.
   2. NECA/BICSI 568.
   3. TIA-569-D.
   4. NECA 101.
   5. NECA 105.

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for pathways specified in Section 270528 "Pathways for Communications Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
   1. Secure raceways and cables to these supports with two-bolt conduit clamps.

F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, according to NFPA 70.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten communications items and their supports to building structural elements by the following methods unless otherwise indicated by code:
   1. To Wood: Fasten with lag screws or through bolts.
   2. To New Concrete: Bolt to concrete inserts.
   3. To Masonry: Use approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

4. To Existing Concrete: Use expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated-driven threaded studs, provided with lock washers and nuts, may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts or Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with strength and anchorage requirements.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for 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 communications materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 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 Section 099123 "Interior Painting" 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 A780.

END OF SECTION 270529

SECTION 270536 - CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Ladder cable tray.
   2. Wire-mesh cable tray.
   3. Cable tray accessories.
   4. Warning signs.

1.3 Related Requirements:

A. Seismic Qualification Data: Certificates, for cable tray for communications systems, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of cable tray.
   1. Include data indicating dimensions and finishes for each type of cable tray indicated.

B. Shop Drawings: For each type of cable tray.
   1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.
   2. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
      a. Vertical and horizontal offsets and transitions.
      b. Clearances for access above and to sides of cable trays.
      c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.

d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

C. Delegated-Design Submittal: For seismic restraints.
1. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer, licensed in the state where Project is located, who is responsible for their preparation.
2. Design Calculations: Calculate requirements for selecting seismic restraints.
3. Detail fabrication, including anchorages and attachments to structure and to supported cable trays.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.
2. Vertical and horizontal offsets and transitions.
3. Clearances for access above and to side of cable trays.
4. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.

B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR CABLE TRAYS

A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
1. Source Limitations: Obtain cable trays and components from single manufacturer.

B. Sizes and Configurations: See the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.

C. Structural Performance: See articles for individual cable tray types for specific values for the following parameters:
1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
3. Load and Safety Factors: Applicable to both side rails and rung capacities.

2.2 LADDER CABLE TRAY

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton (B-line).

2. MonoSystems, Inc.
3. MP Husky USA Cable Tray & Cable Bus.

B. Description:
1. Configuration: Two longitudinal side rails with transverse rungs swaged or welded to side rails, complying with NEMA VE 1.
2. Width: 18 inches unless otherwise indicated on Drawings.
3. Minimum Usable Load Depth: 4 inches.
4. Straight Section Lengths: 10 feet, except where shorter lengths are required to facilitate tray assembly.
5. Rung Spacing: 6 inches o.c.
6. Radius-Fitting Rung Spacing: 9 inches at center of tray's width.
7. Minimum Cable-Bearing Surface for Rungs: 7/8-inch width with radius edges.
8. No portion of the rungs shall protrude below the bottom plane of side rails.
9. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb concentrated load, when tested according to NEMA VE 1.
10. Fitting Minimum Radius: 12 inches.
11. Class Designation: Comply with NEMA VE 1, Class 12A.
12. Splicing Assemblies: Bolted type using serrated flange locknuts.
13. Splice-Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

C. Materials and Finishes:
1. Aluminum:
a. Materials: Alloy 6063-T6 according to ANSI H35.1/H 35.1M for extruded components, and Alloy 5052-H32 according to ANSI H35.1/H 35.1M for fabricated parts.
b. Hardware: Chromium-zinc-plated steel, ASTM F1136.
c. Hardware for Aluminum Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F593 and ASTM F594.

2.3 WIRE-MESH CABLE TRAY

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton (B-line).
2. Hubbell Incorporated (Wiring Device-Kellems).
3. Legrand North America, LLC (Cablofil).
4. MonoSystems, Inc.
5. MP Husky USA Cable Tray & Cable Bus.
6. Snaketray.

B. Description:
1. Configuration: Galvanized- steel wire mesh, complying with NEMA VE 1.
2. Width: 6 inches unless otherwise indicated on Drawings.
3. Minimum Usable Load Depth: 4 inches.
4. Straight Section Lengths: 10 feet, except where shorter lengths are required to facilitate tray assembly.

5. Structural Performance: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb concentrated load, when tested according to NEMA VE 1.
6. Class Designation: Comply with NEMA VE 1, Class 12A.
7. Splicing Assemblies: Bolted type using serrated flange locknuts.
8. Splice-Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

C. Materials and Finishes:
1. Steel:
a. Straight Sections and Fittings: Steel complies with the minimum mechanical properties of ASTM A1011/A1011M, SS, Grade 33.
b. Steel Tray Splice Plates: ASTM A1011/A1011M, HSLAS, Grade 50, Class 1.
c. Fasteners: Steel complies with the minimum mechanical properties of ASTM A510/A510M, Grade 1008.
d. Finish: Hot-dip galvanized after fabrication, complying with ASTM A123/A123M, Class B2.

2.4 CABLE TRAY ACCESSORIES

A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.

B. Barrier Strips: Same materials and finishes as for cable tray.

C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.5 WARNING SIGNS

A. Lettering: 1-1/2-inch- high, black letters on yellow background with legend "Warning! Not To Be Used as Walkway, Ladder, or Support for Ladders or Personnel."

2.6 SOURCE QUALITY CONTROL

A. Testing: Test and inspect cable trays according to NEMA FG 1.

PART 3 - EXECUTION

3.1 CABLE TRAY INSTALLATION

A. Install cable trays according to NEMA FG 1.

B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.

C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.

D. Remove burrs and sharp edges from cable trays.

E. Join aluminum cable tray with splice plates; use four square neck-carriage bolts and locknuts.

F. Fasten cable tray supports to building structure and install seismic restraints.

G. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lb. Comply with requirements in Section 270529 "Hangers and Supports for Communications Systems." Comply with seismic-restraint details according to Section 270548.16 "Seismic Controls for Communications Systems."

H. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.

I. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.

J. Support bus assembly to prevent twisting from eccentric loading.

K. Install center-hung supports for single-rail trays designed for 60 versus 40 percent eccentric loading condition, with a safety factor of 3.

L. Locate and install supports according to NEMA FG 1. Do not install more than one cable tray splice between supports.

M. Support wire-basket cable trays with center support hangers, trapeze hangers or wall brackets.

N. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.

O. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA FG 1. Space connectors and set gaps according to applicable standard.

P. Make changes in direction and elevation using manufacturer's recommended fittings.

Q. Make cable tray connections using manufacturer's recommended fittings.

R. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 078413 "Penetration Firestopping."

S. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

T. Install cable trays with enough workspace to permit access for installing cables.

U. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.2 CABLE TRAY GROUNDING

A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems."

B. Cable trays shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.

C. Cable trays with single-conductor power conductors shall be bonded together with a grounding conductor run in the tray along with the power conductors and bonded to the tray at 72-inch intervals. The grounding conductor shall be sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors," and Article 392, "Cable Trays."

D. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.

E. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

3.3 CABLE INSTALLATION

A. Install cables only when each cable tray run has been completed and inspected.

3.4 CONNECTIONS

A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.

B. Connect pathways to cable trays according to requirements in NEMA VE 2 and NEMA FG 1.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
   2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.

3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
7. Check for improperly sized or installed bonding jumpers.
8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.

B. Prepare test and inspection reports.

3.6 PROTECTION

A. Protect installed cable trays and cables.
1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION 270536

SECTION 270544 - SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS 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 pathway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:
1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

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. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:
1. Material: Galvanized-steel sheet.
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 pathway or cable.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Advance Products & Systems, Inc.
   b. CALPICO, Inc.
   c. HOLDRITE.
   d. Metraflex Company (The).
   e. Pipeline Seal and Insulator, Inc.
   f. 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, provide products by the following:
   a. HOLDRITE.
   b. Or Approved Equal.

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 pathway 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 pathway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
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.

5. Install sleeves for floor penetrations. Extend sleeves installed in floors 6 inches above finished floor level. Install sleeves during erection of floors.

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 pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between pathway 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 pathway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway 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 270544

SECTION 270548 - SEISMIC CONTROLS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Restraint channel bracings.
   2. Restraint cables.
   3. Seismic-restraint accessories.
   4. Mechanical anchor bolts.
   5. Adhesive anchor bolts.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
      a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES.
      b. Annotate to indicate application of each product submitted and compliance with requirements.

B. Delegated-Design Submittal: For each seismic-restraint device.
   1. Include design calculations and details for selecting seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   2. Design Calculations: Calculate static and dynamic loading caused by equipment weight, operation, and seismic forces required to select seismic restraints and for designing vibration isolation bases.
      a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
   3. Seismic-Restraint Details:
      a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
      b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and

values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.

d. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints. Communications components include:
1. Racks.
2. Frames.
3. Cable tray.
4. Conduits.

B. Qualification Data: For professional engineer.

C. Welding certificates.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis. They shall bear anchorage preapproval from OSHPD in addition to preapproval, showing maximum seismic-restraint ratings, by ICC-ES or another agency acceptable to authorities having jurisdiction. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) that support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

E. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:
   a. See Structural Code Sheet for seismic values.

2.2 RESTRAINT CHANNEL BRACINGS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Atkore International (Unistrut).
   2. Eaton (B-line).
   3. Hilti, Inc.
   4. Mason Industries, Inc.

B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.3 RESTRAINT CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Gripple Inc.
   2. Kinetics Noise Control, Inc.
   3. nVent (CADDY).
   4. Vibration Mountings & Controls, Inc.

B. Restraint Cables: ASTM A603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.4 SEISMIC-RESTRAINT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton (B-line).
   2. Kinetics Noise Control, Inc.
   3. Mason Industries, Inc.

B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.

D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.

E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.5 MECHANICAL ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton (B-line).
2. Hilti, Inc.
3. Kinetics Noise Control, Inc.
4. Mason Industries, Inc.

B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

2.6 ADHESIVE ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hilti, Inc.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.

B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receiveseismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for reinforcement and cast-in-place anchors to verify actual locations before installation.

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

3.2 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods caused by seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

B. Equipment and Hanger Restraints:
   1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
   2. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

F. Drilled-in Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
   4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
   5. Set anchors to manufacturer's recommended torque using a torque wrench.

6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
   2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
   3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
   4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
   5. Test to 90 percent of rated proof load of device.

C. Seismic controls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 270548

SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Telecommunications mounting elements.
2. Backboards.
3. Grounding.

B. Related Requirements:
1. Section 270536 "Cable Trays for Communications Systems" for cable trays and accessories.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. LAN: Local area network.

C. RCDD: Registered Communications Distribution Designer.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.
1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.

3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
3. Field Inspector: Currently registered by BICSI as RCDD Commercial Installer, Level 2 to perform the on-site inspection.

PART 2 - PRODUCTS

2.1 BACKBOARDS

A. Backboards: Plywood, with intumescent fire-retardant paint, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels specified in Section 061000 "Rough Carpentry."

2.2 GROUNDING

A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

B. Comply with J-STD-607-A.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.

C. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with Owner.
   1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
   2. Record agreements reached in meetings and distribute them to other participants.
   3. Adjust arrangements and locations of room contents to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment per Owner's direction.

D. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.2 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 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.3 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-B, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.4 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with J-STD-607-A.

3.5 IDENTIFICATION

A. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

END OF SECTION 271100

SECTION 280528 - PATHWAYS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Metal conduits and fittings.
2. Metal wireways and auxiliary gutters.
3. Boxes, enclosures, and cabinets.

B. Related Requirements:
1. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
2. Section 260533 "Raceways and Boxes for Electrical Systems" for conduits, wireways, surface raceways, boxes, enclosures, cabinets, handholes, and faceplate adapters serving electrical systems.

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 pathways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of pathway groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFC Cable Systems, Inc.
2. Allied Tube & Conduit; a Tyco International Ltd. Co.
3. Anamet Electrical, Inc.
4. Electri-Flex Company.
5. O-Z/Gedney; a brand of EGS Electrical Group.
6. Picoma Industries; Subsidiary of Mueller Water Products, Inc.
7. Republic Conduit.
8. Robroy Industries.
9. Southwire Company.
10. Thomas & Betts Corporation.
11. Western Tube and Conduit Corporation.
12. Wheatland Tube Company; a division of John Maneely Company.

B. General Requirements for Metal Conduits and Fittings:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

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. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Fittings for EMT:
   a. Material: Steel.
   b. Type: Compression.
2. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.

3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

H. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Adalet.
2. Cooper Technologies Company; Cooper Crouse-Hinds.
3. EGS/Appleton Electric.
4. Erickson Electrical Equipment Company.
5. Hoffman; a Pentair company.
6. Hubbell Incorporated; Killark Division.
7. Lamson & Sessions; Carlon Electrical Products.
8. Milbank Manufacturing Co.
9. Molex; Woodhead Brand.
10. Mono-Systems, Inc.
11. O-Z/Gedney; a brand of EGS Electrical Group.
12. RACO; a Hubbell company.
13. Robroy Industries.
14. Spring City Electrical Manufacturing Company.
15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
16. Thomas & Betts Corporation.
17. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets:
1. Comply with TIA-569-B.
2. 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. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

H. Device Box Dimensions: 4 inches square by 2-1/8 inches deep unless otherwise noted.

I. Gangable boxes are not allowed.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
   1. Exposed Conduit: IMC.
   2. Concealed Conduit, Aboveground: EMT.
   3. Underground Conduit: RNC, Type EPC-40-PVC.
   4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply pathway products as specified below unless otherwise indicated:
   1. Exposed, Not Subject to Physical Damage: EMT.
   2. Exposed, Not Subject to Severe Physical Damage: EMT.
   3. Exposed and Subject to Severe Physical Damage: GRC. Pathway locations include the following:
      a. Mechanical rooms.
   4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
   5. Damp or Wet Locations: GRC.
   6. 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.

C. Minimum Pathway Size: 1-inch trade size. Minimum size for optical-fiber cables is 1 1/4 inch.

D. Pathway Fittings: Compatible with pathways and suitable for use and location.
   1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
   2. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.

E. Install surface pathways only where indicated on Drawings.

F. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with NECA 1, NECA 101, TIA-569-A and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

B. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

C. Complete pathway 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 two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches of enclosures to which attached.

I. Pathways Embedded in Slabs:
1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot intervals.
2. Arrange pathways to cross building expansion joints at right angles with expansion fittings.
3. Arrange pathways to keep a minimum of 1 inch of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from ENT to GRC before rising above floor.

J. Stub-ups to Above Recessed Ceilings:
1. Use EMT, IMC, or RMC for pathways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Coat field-cut threads on PVC-coated pathway 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 insulated bushings on conduits terminated with locknuts.

N. Install pathways 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 of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

Q. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.

R. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway sealing fittings according to NFPA 70.

S. Install devices to seal pathway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service pathway enters a building or structure.
3. Where otherwise required by NFPA 70.

T. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

U. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
   d. Attics: 135 deg F temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

V. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to top of box unless otherwise indicated.

W. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

X. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

Y. 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.

Z. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

AA. Set metal floor boxes level and flush with finished floor surface.

BB. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.4 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 PROTECTION

A. Protect coatings, finishes, and cabinets from damage or deterioration.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 280528

SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM 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. Section Includes:
1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Heat detectors.
5. Notification appliances.
6. Remote annunciator.
7. Addressable interface device.
8. Cell Phone Dialer.
9. Campus Emergency System Notification system.
10. Fire Alarm Bell.
11. Emergency responder radio coverage system.

B. Related Requirements:
1. Section 260519 "Low-voltage Electrical Power Conductors and Cables" for cables and conductors for fire-alarm systems.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. NICET: National Institute for Certification in Engineering Technologies.

1.4 SYSTEM DESCRIPTION

A. Noncoded, UL-certified addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.

1.5 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.6 ACTION SUBMITTALS

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

B. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
1. Comply with recommendations in the "Documentation" Section of the "Fundamentals" Chapter in NFPA 72.
2. Include voltage drop calculations for notification appliance circuits.
3. Include battery-size calculations.
4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
6. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
7. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

C. Shop Drawings: For Emergency responder radio coverage system: Include plans, elevations, sections, details, and attachments to other work.

D. General Submittal Requirements:
1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:
a. Trained and certified by manufacturer in fire-alarm system design.
b. NICET-certified fire-alarm technician, Level III minimum.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," deliver copies to authorities having jurisdiction and include the following:
   1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
   2. Provide documents according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
   3. Record copy of site-specific software.
   4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
      a. Frequency of testing of installed components.
      b. Frequency of inspection of installed components.
      c. Requirements and recommendations related to results of maintenance.
      d. Manufacturer's user training manuals.
   5. Manufacturer's required maintenance related to system warranty requirements.
   6. Abbreviated operating instructions for mounting at fire-alarm control 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.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.

C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. NFPA Certification: Obtain certification according to NFPA 72.

1.10 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning with Substantial Completion, provide software support for two years.

C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. A complete noncoded, addressable microprocessor-based system, with multiplexed signal transmission and voice/strobe evacuation.

B. Automatic sensitivity control of certain smoke detectors.

C. All components provided shall be listed for use with the selected system.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide products from Fire Lite Alarms; a Honeywell company

B. All manufacturers and components shall be open source or non-proprietary system where the parts, supplies, programming, software and all other portions or aspects of the system are available from multiple independent competitive dealers or suppliers on the open market. The use of non-proprietary equipment and systems will allow any certified technician to obtain parts, programs, perform maintenance or subcontract repairs competitively.

C. The following companies/distributors carry the Fire Lite products for competitive bidding:
1. ADI (Columbia & Charleston SC)
2. ANIXTER (Charlotte NC & Charleston SC)
3. The Systems Depot (Fayetteville & Hickory NC)
4. Silmar (Charleston & Greenville SC)
5. Palmetto Fire Services (Little River SC)

2.3 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
   1. Manual stations.
   2. Heat detectors.
   3. Smoke detectors.
   4. Duct smoke detectors.
   5. Automatic sprinkler system water flow.
   6. Heat detectors in elevator shaft and pit.

B. Fire-alarm signal shall initiate the following actions:
   1. Continuously operate alarm notification appliances.
   2. Identify alarm 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. Activate voice/alarm communication system.
   6. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
   7. Close smoke dampers in air ducts of designated air-conditioning duct systems.
   8. Recall elevators to primary or alternate recall floors.
   9. Activate elevator power shunt trip.
   10. Record events in the system memory. The system shall provide a means to recall alarms and trouble conditions in chronological order for the purpose of recreating an event history. A separate alarm and trouble log shall be provided.

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.

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 primary power at fire-alarm control unit.
   4. Ground or a single break in fire-alarm control unit internal circuits.
   5. Abnormal ac voltage at fire-alarm control unit.
   6. Break in standby battery circuitry.
   7. Failure of battery charging.
   8. Abnormal position of any switch at fire-alarm control unit or annunciator.

E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators.

2.4 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit (Basis of Design: Fire-Lite ES-200S):
   1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.

a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
b. Include a real-time clock for time annotation of events on the event recorder and printer.

2. Addressable initiation devices that communicate device identity and status.
   a. Smoke sensors shall additionally communicate sensitivity setting.
   b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
3. Addressable control circuits for operation of mechanical equipment.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
1. Annunciator and Display: Liquid-crystal type, 2 line(s) of 40 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

C. Circuits:
1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.
   a. Initiating Device Circuits: Class B.
   b. Notification Appliance Circuits: Class B.
   c. Signaling Line Circuits: Class B.
   d. Install no more than 50 addressable devices on each signaling line circuit.
2. Serial Interfaces: Two RS-232 ports for printers.
3. All fire alarm circuits shall be installed in raceway. See Section 260533 "Raceways and Boxes for Electrical Systems" for installation details.

D. Elevator Recall:
1. Smoke detectors at the following locations shall initiate automatic elevator recall.
   a. Elevator lobby detectors except the lobby detector on designated floor.
   b. Smoke detector in elevator machine room.
   c. Smoke detectors in elevator hoist ways.
2. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.
3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associate with the location without time delay.

E. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.

F. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

G. Voice/Alarm Signaling Service: Central emergency communication system with microphones, preamplifiers, amplifiers, and tone generators provided as a special module that is part of fire-alarm control unit.
   1. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711 and be listed by an NRTL.
      a. Allow the application of and evacuation signal to indicated number of zones and, at same time, allow voice paging to the other zones selectively or in any combination.
      b. Programmable tone and message sequence selection.
      c. Standard digitally recorded messages for "Evacuation" and "All Clear."
      d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification appliance circuits of fire-alarm control unit.
   2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
   3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.

H. Primary Power (Basis of Design Fire-Lite Model FCPS-24FS8) : 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.
   1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

I. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
   1. Batteries: Sealed lead calcium.

J. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.5 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes (Basis of Design: Fire-Lite BG-12LX): Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
   1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
   2. Station Reset: Key- or wrench-operated switch.

2.6 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 and power-on status.
   7. Color: White

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.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
   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.).
   3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
   4. Each sensor shall have multiple levels of detection sensitivity.
   5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
   6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.7 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
   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.

C. 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.

D. Housing color shall be white.

2.8 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. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens. The word "**ALERT**" is engraved in minimum 1-inch-high letters on the lens.
   1. Rated Light Output:
      a. 15/30/75/110/177 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, white.
   7. Mounting backbox: device shall fit in a single standard depth backbox.

C. Voice/Tone Notification Appliances:
   1. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.
   2. High-Range Units: Rated 2 to 15 W.
   3. Low-Range Units: Rated 1 to 2 W.
   4. Mounting: surface mounted and bidirectional.
   5. Matching Transformers: Tap range matched to acoustical environment of speaker location.
   6. Mounting Faceplate: Factory finished, white.
   7. Mounting backbox: device shall fit in a single backbox.

2.9 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
   1. Mounting: surface, NEMA 250, Type 1, catalog ANN-SB80KIT-W.

B. Color by Architect from standard manufacturer colors (not red).

C. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.10 ADDRESSABLE INTERFACE DEVICE

A. General:
   1. Include address-setting means on the module.
   2. Store an internal identifying code for control panel use to identify the module type.
   3. Listed for controlling HVAC fan motor controllers.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

C. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall and circuit-breaker shunt trip for power shutdown.
   1. Allow the control panel to switch the relay contacts on command.
   2. Have a minimum of two normally open and two normally closed contacts available for field wiring.

D. Control Module:
   1. Operate notification devices.
   2. Operate solenoids for use in sprinkler service.

2.11 CELL PHONE COMMUNICATOR

A. Provide a cell phone module/dialer for connection to cellular phone lines for permanent means of communication of the fire alarm system to the supervising station.

2.12 NETWORK

A. Provide network connectivity to the fire alarm control panel as a secondary means of communication.

2.13 CAMPUS EMERGENCY NOTIFICATION SYSTEM

A. The following equipment (Basis of Design: Cooper Wheellock) will be provided by the fire alarm vendor for the antennae-based notification system:

1. SPB-80/4 Audio Power Booster Panels as needed to accommodate the FA/MNS Speakers. Provide at least 25% spare capacity on all booster panels (amplifiers) for future expansion.

B. The fire alarm control panel will have to be capable of receiving a fiber input from the CCU campus notification system to activate the strobe lights when emergency notification system is activated.

C. Provide audio cable input from the fire alarm control panel.

2.14 FIRE ALARM BELL

A. Provide a 120 Volt electronic bell on the exterior of the building just outside the fire riser room.

B. Fire alarm bell shall be grey.

2.15 EMERGENCY RESPONDER RADIO COVERAGE SYSTEM

A. Description: Emergency responder radio coverage systems use a combination of bidirectional amplifiers and distributed antenna systems to boost signals for sustaining two-way radio communications throughout a facility, including stairwells, underground tunnels, parking garages, and other challenging areas.

B. The building shall be tested for coverage after building exterior skin and windows are installed.

C. Performance Criteria:
1. Regulatory Requirements:
   a. In accordance with the International Building Code (IBC), emergency responder radio coverage systems must be designed, installed, and maintained.
   b. In accordance with NFPA 72, emergency responder radio coverage systems must be designed, installed, and maintained in accordance with NFPA 1221.

2. General Characteristics:
   a. Where leaky feeder cable is used as antenna, it must neither be required to be installed in metal raceway nor meet survivability requirements.
   b. Feeder and riser coaxial cables must be rated as plenum cables.
   c. Feeder coaxial cables must be connected to riser coaxial cables using hybrid coupler devices of value determined by overall design.
   d. Where emergency responder radio coverage system is used in lieu of two-way in-building wired emergency communications system, design of system must be approved by authorities having jurisdiction. Riser coaxial cables must be rated as riser cables and 2-hour-rated.
   e. Connection between riser and feeder coaxial cables must be made within 2-hour-rated enclosure, and passage of feeder cable in and out of 2-hour-rated enclosure must be firestopped to 2-hour ratings.

D. Emergency responder radio coverage system shall be monitored by the fire alarm. See Drawing E3.01 for monitoring points.

E. Emergency responder radio coverage system shall tie into the fiber campus network for connectivity to the main antennae located in the Library Learning Commons building. Fiber provided by CCU.

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.
   1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

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

3.2 EQUIPMENT INSTALLATION

A. Comply with current edition of NFPA 72 for installation of fire-alarm equipment.

B. Install wall-mounted equipment, with tops of cabinets not more than 72 inches above the finished floor.
   1. Comply with requirements for seismic-restraint devices specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

C. Smoke- or Heat-Detector Spacing:
   1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
   2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
   3. Smooth ceiling spacing shall not exceed 30 feet.
   4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex B in NFPA 72.
   5. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.
   6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.

D. Duct Smoke Detectors: Comply with NFPA 72 and International Mechanical Code 2021. Install sampling tubes so they extend the full width of duct.

E. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.

F. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

G. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

H. 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.

I. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling.

J. Device Location-Indicating Lights: Locate in public space near the device they monitor. All relays and modules with indicating lights will be visible without removing ceiling tiles or opening doors or enclosures.

K. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches above the finished floor.

L. Annunciator: Install with top of panel not more than 72 inches above the finished floor.

M. Antenna for Radio Alarm Transmitter: Mount to building structure where indicated. Use mounting arrangement and substrate connection that resists 100-mph wind load with a gust factor of 1.3 without damage. Coordinate location with owner/architect for full coverage.

3.3 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
   1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
   1. Smoke dampers in air ducts of designated air-conditioning duct systems.
   2. Alarm-initiating connection to elevator recall system and components.
   3. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
   4. Supervisory connections at valve supervisory switches.
   5. Supervisory connections at elevator shunt trip breaker.

C. Provide all wiring in EMT conduit.

3.4 PROGRAMMING

A. Coordinate room numbering with the Owner prior to programming the fire alarm system. Room numbers are not necessarily the ones shown on contract documents.

B. Coordinate sequence of operation with owner for FM suppression system and pre-action system.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
   1. Provide devices labeled with device address and loop number. Example, Smoke detector 89 will be labeled L1-D089 and pull station 70 will bel labeled L1-M070.

B. Install framed instructions in a location visible from fire-alarm control unit.

C. Provide red painted circuit breaker in source panel that is capable of being locked in the "on" position.

D. Provide red junction boxes.

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.

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 inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. 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.

D. Tests and Inspections:
   1. Visual Inspection: Conduct visual inspection prior to testing.
      a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals " Chapter.

b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. 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. CCU Fire Marshal and alarm technician shall be present for every test.

F. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

G. Fire-alarm system will be considered defective if it does not pass tests and inspections.

H. Prepare test and inspection reports.

I. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

J. 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 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system. The factory representative shall provide training and certification to the CCU alarm technician.

END OF SECTION 283111

SECTION 31 10 00
SITE CLEARING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Removing surface debris.
2. Removing designated paving, curbs, and slabs.
3. Removing designated trees, shrubs, and other plant life.
4. Removing abandoned utilities and structures where indicated.
5. Plugging abandoned utilities and filling abandoned structures where indicated.
6. Protecting plant life and structures designated to remain.

B. Related Sections:
1. Section 31 23 16 - Excavation and Fill: Topsoil and subsoil removal, proofrolling.
2. Section 31 23 18 - Rock Removal.
3. Section 32 93 00 - Plants: Tree and root pruning.

1.2 REFERENCES

A. SCDOT Standard Specifications:
1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.

1.3 QUALITY ASSURANCE

A. Perform Work in accordance with Section 201 of the SCDOT Standard Specifications.

B. Maintain one copy of document on site.

C. Conform to applicable code for environmental requirements and disposal of debris.

PART 2 PRODUCTS – Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify existing plant life designated to remain is tagged or identified.

C. Identify waste area or salvage area for placing removed materials when materials are indicated to remain on site.

3.2 PREPARATION

A. Call local utility line information service indicated on Drawings not less than three working days before performing Work.
   1. Request underground utilities to be located and marked within and surrounding construction areas.

3.3 PROTECTION

A. Locate, identify, and protect from damage utilities indicated to remain.

B. Protect trees, plant growth, and features designated to remain as final landscaping.

C. Protect bench marks and survey control points from damage or displacement.

3.4 CLEARING

A. Remove trees and shrubs within areas indicated on Drawings.

B. Remove stumps, main root ball, root system, surface rock, and pavements to depth of 12 inches below proposed Subgrade elevation.

C. Clear undergrowth and deadwood without disturbing subsoil.

3.5 REMOVAL

A. Remove debris, rock, and extracted plant life from site.

B. Remove paving, curbs, and site slabs.

C. Where indicated on Drawings partially remove paving, curbs, and slabs. Neatly saw cut edges at right angle to surface.

D. Remove abandoned utilities. Indicate removal termination point for underground utilities on Record Documents.

E. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.

F. Do not burn or bury materials on site unless authorized in writing by authority having jurisdiction.

G. Leave site in clean condition.

3.6 SCHEDULES – Not used

END OF SECTION

SECTION 31 23 16
EXCAVATION AND FILL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Excavating topsoil.
2. Excavating subsoil for buildings, pavements, and landscape.
3. Backfilling building perimeter to subgrade elevations.
4. Backfilling site structures to subgrade elevations.
5. Filling under pavements or slabs-on-grade.
6. Undercutting and filling over-excavation.
7. Disposal of excess material.

B. Related Sections:
1. Section 31 10 00 - Site Clearing: Clearing site prior to excavation.
2. Section 31 25 13 - Erosion Controls: Controlling sediment and erosion from Work of this section.
3. Section 31 23 17 - Trenching: Excavating and backfilling for utilities.
4. Section 31 23 18 - Rock Removal.
5. Section 32 91 19 - Landscape Grading: Finish grading with topsoil to contours.

1.2 REFERENCES

A. SCDOT Standard Specifications:
1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.

B. American Association of State Highway and Transportation Officials:
1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

C. ASTM International:
1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
2. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand- Cone Method.
3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
5. ASTM D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
6. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
7. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
8. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock

in Place by Nuclear Methods (Shallow Depth).

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.

C. Dewatering Plan: Describe dewatering methods to be used to keep excavations dry if required.

D. Samples: Submit, in air-tight containers, 10-pound sample of each type of fill to testing laboratory.

E. Materials Source DOT Approval: Submit certification that aggregate and soil material suppliers are approved by the State Department of Transportation.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with Division 200 - Earthwork of the SCDOT Standard Specifications.

B. Maintain one copy of document on site.

C. Prepare excavation protection plan under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Project location.

PART 2 PRODUCTS

2.1 MATERIALS

A. Topsoil: Original surface soil typical of the area which is capable of supporting native plant growth. It shall be free of large stones, roots, waste, debris, contamination, or other unsuitable material which might hinder plant growth.

B. Subsoil: Clean natural soil with a plasticity index of 15 or less that is free of clay, rock, or gravel lumps larger than 2 inches in any dimension, debris, waste, frozen material, and any other deleterious material that might cause settlement. Suitable material excavated from the site may be used as subsoil fill under optimum moisture conditions.

C. Granular Fill: Clean sand, slightly silty sand, or slightly clayey sand having a Unified Soil Classification of SW, SP, SP-SM, or SP-SC.

D. Structural Fill: Clean course aggregate Gradation No. 57 conforming to Sections 801 of the SCDOT Standard Specifications.

E. Borrow Material: Conform to subsoil requirements.

2.2 ACCESSORIES

A. Geotextile Fabric: Non-woven, non-biodegradable, conforming to Section 804 of the SCDOT Standard Specifications.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify survey bench mark and intended elevations for the Work are as indicated on Drawings.

C. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.

D. Verify underground structures are anchored to their own foundations to avoid flotation after backfilling.

E. Verify structural ability of unsupported walls to support loads imposed by fill.

3.2 PREPARATION FOR EXCAVATION

A. Call Local Utility Line Information service as indicated on Drawings not less than three working days before performing Work.
   1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Identify required lines, levels, contours, and datum.

C. Notify utility company to remove and relocate utilities.

D. Protect utilities indicated to remain from damage.

E. Protect plant life, lawns, rock outcropping, and other features remaining as portion of final landscaping.

F. Protect bench marks, survey control point, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

3.3 TOPSOIL EXCAVATION

A. Excavate topsoil from areas to be further excavated, re-landscaped, or regraded without mixing with foreign materials for use in finish grading.

B. Do not excavate wet topsoil.

C. Stockpile in area designated on site and protect from erosion.

D. Remove from site excess topsoil not intended for reuse.

3.4 SUBSOIL EXCAVATION

A. Underpin adjacent structures which may be damaged by excavation work.

B. Excavate subsoil to accommodate building foundations, structures, slabs-on-grade, paving, landscaping, and construction operations.

C. Compact disturbed load bearing soil in direct contact with foundations to original bearing capacity.

D. Slope banks with machine to angle of repose or less until shored.

E. Do not interfere with 45-degree bearing splay of foundations.

F. Grade top perimeter of excavation to prevent surface water from draining into excavation.

G. Trim excavation. Remove loose matter.

H. Remove lumped subsoil, boulders, and rock up to 1/3 cubic yard measured by volume. Remove larger material as specified in Section 31 23 18.

I. Notify Engineer and testing agency of unexpected subsurface conditions.

J. Correct areas over excavated with granular fill and compact as required for fill areas.

K. Remove excess and unsuitable material from site.

L. Repair or replace items indicated to remain damaged by excavation.

M. Excavate subsoil from areas to be further excavated, re-landscaped, or regraded.

N. Do not excavate wet subsoil or excavate and process wet material to obtain optimum moisture content.

O. Remove from site excess subsoil not intended for reuse.

P. Benching Slopes: Horizontally bench existing slopes greater than 3:1 to key placed fill material into slope to provide firm bearing.

Q. Stability: Replace damaged or displaced subsoil as specified for fill.

3.5 SHEETING AND SHORING

A. Sheet, shore, and brace excavations to prevent danger to persons, structures, and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.

B. Support excavations more than 5 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.

C. Design sheeting and shoring to be left in place as part of the completed Work, cut off minimum 18 inches below finished subgrade, or design sheeting and shoring to be removed at completion of excavation work.

D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.

E. Repair damage to new and existing Work from settlement, water, or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.6 SURFACE WATER CONTROL

A. Control and remove unanticipated water seepage into excavation.

B. Provide ditches, berms, and other devices to divert and drain surface water from excavation area as specified in Section 31 25 13.

C. Divert surface water and seepage water within excavation areas into sumps or settling basins prior to pumping water into drainage channels and storm drains.

3.7 DEWATERING

A. Design and provide dewatering system to permit Work to be completed on dry and stable subgrade.

B. Operate dewatering system continuously until backfill is minimum 2 feet above normal ground water table elevation.

C. When dewatering system cannot control water within excavation, notify Engineer and stop excavation work.
   1. Supplement or modify dewatering system and provide other remedial measures to control water within excavation.
   2. Demonstrate dewatering system operation complies with performance requirements before resuming excavation operations.

D. Modify dewatering systems when operation causes or threatens to cause damage to new construction, existing site improvements, adjacent property, or adjacent water wells.

E. Discharge ground water and seepage water within excavation areas into sumps or settling basins prior to pumping water into drainage channels and storm drains.

F. Remove dewatering and surface water control systems after dewatering operations are discontinued.

3.8 PROOF ROLLING

A. Proof roll areas to receive fill, pavement and building slabs to identify areas of soft yielding soils.
   1. Use loaded tandem-axle pneumatic tired dump truck or large smooth drum roller.
   2. Load equipment to maximum 50 tons gross weight and make a minimum of four passes with two passes perpendicular to the others.

B. Undercut such areas to firm soil, backfill with granular fill, and compact to density equal to or greater than requirements for subsequent fill material.

C. Do not proof roll or undercut until soil has been dewatered.

3.9 BACKFILLING

A. Scarify subgrade surface to depth of 4 inches.

B. Compact subgrade to density requirements for subsequent backfill materials.

C. Backfill areas to contours and elevations with unfrozen materials.

D. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

E. Place fill material in continuous layers and compact in accordance with Schedule at end of this Section.

F. Employ placement method that does not disturb or damage other work.

G. Maintain optimum moisture content of backfill materials to attain required compaction density.

H. Support foundation walls and structures prior to backfilling.

I. Backfill simultaneously on each side of unsupported foundation walls and structures until supports are in place.

J. Slope grade away from building minimum 2 percent slope for minimum distance of 10 feet, unless noted otherwise.

K. Make gradual grade changes. Blend slope into level areas.

L. Remove surplus backfill materials from site.

3.10 BRIDGING DEGRADED SOILS – Not Used

3.11 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Top Surface of Backfilling Within Building and Paved Areas: Plus or minus 1 inch from required elevations.

C. Top Surface of Backfilling Within Landscape Areas: Plus or minus 2 inches from required elevations.

3.12 PROTECTION

A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.

B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

C. Protect structures, utilities, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

D. Repair or replace items indicated to remain damaged by excavation or filling.

3.13 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Independent laboratory, field inspecting, testing, adjusting, and balancing.

B. Request visual inspection of bearing surfaces by Engineer and inspection agency before installing subsequent work.

C. Laboratory Material Tests: In accordance with ASTM D1557 or AASHTO T180.
D. In-Place Compaction Tests: In accordance with the following:
   1. Density Tests: ASTM D1556, ASTM D2167, or ASTM D2922.
   2. Moisture Tests: ASTM D3017.

E. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

F. Frequency of Tests:
   1. Building and Pavement Areas: Twice per lift for every 5,000 square feet.
   2. Landscape Areas: Twice per lift for every 10,000 square feet.

3.14 SCHEDULES

A. Under Pavement and Slabs:
   1. Maximum 8-inch compacted depth.
   2. Compact material to a minimum of 95 percent of maximum density, except the top 12 inches.
   3. Compact top 12 inches to a minimum of 98 percent of maximum density.

B. Under Landscape Areas:

1. Maximum 8-inch compacted depth.
2. Compact to minimum 90 percent of maximum density.

C. Footing Foundation Fill:
1. Structural fill to maximum 12-inch compacted depth.
2. Compact to 98 percent of maximum density.

END OF SECTION

SECTION 31 23 17
TRENCHING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Excavating trenches for utilities and utility structures.
2. Bedding.
3. Backfilling and compacting to subgrade elevations.
4. Sheeting and Shoring.
5. Dewatering.
6. Compacting backfill material.

B. Related Sections:

1. Section 33 23 13 - Erosion Controls: Diversion of water from excavations.
2. Section 31 23 16 - Excavation and Fill: Topsoil and subsoil removal from site surface.
3. Section 31 23 18 - Rock Removal: Removal of rock found during excavating.
4. Section 31 25 13 – Erosion Controls: Controlling sediment and erosion from Work of this section.
5. Section 33 11 16 - Water Utility Distribution Piping: Water piping and appurtenances.
6. Section 33 31 00 - Sanitary Utility Sewerage Piping: Sanitary sewer piping and bedding.
7. Section 33 41 00 - Storm Utility Drainage Piping: Storm sewer piping and bedding.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:
1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:
1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
2. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand- Cone Method.
3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
5. ASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
6. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

7. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

C. SCDOT Standard Specifications:
1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.

1.3 DEFINITIONS

A. Utility: Any buried pipe, duct, conduit, or cable.

B. Utility Structures: Manholes, catch basins, inlets, valve vaults, hand holes, and other utility access structures as indicated on Drawings.

C. Trench Terminology:
1. Foundation: Area under bottom of trench supporting bedding.
2. Bedding: Fill placed under utility pipe.
3. Haunching: Fill placed from bedding to center line of pipe.
4. Initial Backfill: Fill place from center line to 6 to 12 inches above top of pipe.
5. Final Backfill: Fill placed from initial backfill to subgrade.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan. Prepare excavation protection plan under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of South Carolina.

C. Dewatering Plan if required: Describe methods of dewatering and disposal of water.

D. Product Data: Submit data for geotextile fabric indicating fabric and construction.

E. Samples: Submit to testing laboratory, in air-tight containers, 10-pound sample of each type of fill.

F. Materials Source: Submit name of imported fill material suppliers.

G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with Division 200 of SCDOT Standard Specifications.

B. Maintain one copy of document on site.

1.6 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.7 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 PRODUCTS

2.1 BACKFILL MATERIALS

A. Subsoil Fill: Clean natural soil with a plasticity index of 15 or less that is free of clay, rock, or gravel lumps larger than 2 inches in any dimension; debris; waste; frozen material; and any other deleterious material that might cause settlement. Suitable material excavated from the site may be used as subsoil fill under optimum moisture conditions.

B. Granular Fill: Clean sand, slightly silty sand, or slightly clayey sand having a Unified Soil Classification of SW, SP, SP-SM or SP-SC.

C. Foundation Stone: Clean course aggregate Gradation No. 57 conforming to Sections 801 of the SCDOT Standard Specifications.

D. Bedding and Haunching Material:
1. Rigid Pipe: Granular Fill.
2. Flexible Pipe: Foundation Stone.

E. Bedding for Structures: Foundation Stone.

F. Initial Backfill to 6 inches Minimum Above Utility:
1. Rigid Pipe: Subsoil Fill.
2. Flexible Pipe: Foundation Stone.

G. Final Backfill to Subgrade:
1. Under Pavement: Granular Fill.
2. Under Landscape: Subsoil Fill.

2.2 ACCESSORIES

A. Geotextile Fabric: Non-woven, non-biodegradable conforming to Section 804 of the SCDOT Standard Specifications.

B. Concrete: Concrete conforming to Section 701 of the SCDOT Standard Specifications.
1. Compressive strength of 3,000 psi at 28 days.
2. Air entrained.
3. Water cement ratio of 0.488 with rounded aggregate and 0.532 with angular aggregate.
4. Maximum slump of 3.5 inches for vibrated concrete and 4 inches for non-vibrated concrete.

5. Minimum cement content of 564 lbs per cubic yard for vibrated and 602 lbs. per cubic yard for non-vibrated concrete.

PART 3 EXECUTION

3.1 PREPARATION

A. Call local utility line information service indicated on Drawings not less than three working days before performing Work.
   1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Identify required lines, levels, contours, and datum locations.

C. Protect plant life, lawns, rock outcropping, and other features remaining as portion of final landscaping.

D. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

E. Maintain and protect above and below grade utilities indicated to remain.

F. Establish temporary traffic control and detours when trenching is performed in public right-of-way. Relocate controls and reroute traffic as required during progress of Work.

3.2 LINES AND GRADES

A. Excavate to lines and grades indicated on Drawings.
   1. Owner reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.

B. Use laser-beam instrument with qualified operator to establish lines and grades.

3.3 TRENCHING

A. Excavate subsoil required for utilities.

B. Remove lumped subsoil, boulders, and rock up of 1/3 cubic yard, measured by volume. Remove larger material as specified in Section 31 23 18.

C. Perform excavation within 48 inches of existing utility service in accordance with utility's requirements.

D. Do not advance open trench more than 200 feet ahead of installed pipe.

E. Remove water or materials that interfere with Work.

F. Trench Width: Excavate bottom of trenches maximum 16 inches wider than outside diameter of pipe or as indicated on Drawings.

G. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and pipe.

H. Maintain vertical faces to an elevation equal to 12 inches above top of pipe.
1. When Project conditions permit, side walls may be sloped or benched above this elevation.
2. When side walls cannot be sloped, provide sheeting and shoring to protect excavation as specified in this Section.

I. Support Utilities and Structures:
1. Keep trench width at top of trench to practical minimum to protect adjacent or crossing utility lines
2. Support utilities crossing trench by means acceptable to utility company.
3. Do not interfere with 45-degree bearing splay of foundations.
4. Provide temporary support for structures above and below ground.

J. When subsurface materials at bottom of trench are loose or soft, excavate to firm subgrade or to depth directed by Engineer.
1. Cut out soft areas of subgrade not capable of compaction in place.
2. Backfill with foundation stone and compact to density equal to or greater than requirements for subsequent backfill material.

K. Trim Excavation: Hand trim for bell and spigot pipe joints where required. Remove loose matter.

L. Correct areas over excavated areas with compacted backfill as specified for authorized excavation or replace with fill concrete as directed by Engineer.

M. Place geotextile fabric over trench foundation stone prior to placing subsequent bedding materials.

3.4 SHEETING AND SHORING

A. Sheet, shore, and brace excavations to prevent danger to persons, structures, and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.

B. Support trenches more than 5 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.

C. Design sheeting and shoring to be removed at completion of excavation work unless approved by Engineer.

D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.

E. Repair damage to new and existing Work from settlement, water, or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.5 SURFACE WATER CONTROL

A. Control and remove unanticipated water seepage into excavation.

B. Provide ditches, berms, and other devices to divert and drain surface water from excavation area as specified in Section 31 25 13.

C. Divert surface water and seepage water within excavation areas into sumps or settling basins prior to pumping water into drainage channels and storm drains.

3.6 DEWATERING

A. Design and provide dewatering system to permit Work to be completed on dry and stable subgrade.

B. Operate dewatering system continuously until backfill is minimum 2 feet above normal ground water table elevation.

C. When dewatering system cannot control water within excavation, notify Engineer and stop excavation work.
   1. Supplement or modify dewatering system and provide other remedial measures to control water within excavation.
   2. Demonstrate dewatering system operation complies with performance requirements before resuming excavation operations.

D. Modify dewatering systems when operation causes or threatens to cause damage to new construction, existing site improvements, adjacent property, or adjacent water wells.

E. Discharge ground water and seepage water within excavation areas through filter bags or into settling basins prior to pumping water into drainage channels and storm drains.

F. Remove dewatering and surface water control systems after dewatering operations are discontinued.

3.7 BEDDING, HAUNCHING, AND INITIAL BACKFILL

A. Place bedding full width of trench to the depth indicated on Drawings and compact to 95 percent maximum density. Excavate for pipe bells.

B. Install utility pipe and conduit in accordance with the respective utility section.

C. Support pipe uniformly along entire length of pipe.

D. Carefully place haunching material to center of pipe, rod and tamp material to fill voids and provide uniform support of pipe haunches. Compact to 90 percent maximum density.

E. Carefully place initial backfill to 6 inches above top of pipe or to depth indicated on Drawings. Compact to 95 percent maximum density.

3.8 FINAL BACKFILLING TO SUBGRADE

A. Backfill trenches to contours and elevations with unfrozen fill materials.

B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

C. Place fill material in continuous layers and compact in accordance with schedule at end of this Section.

D. Employ placement method that does not disturb or damage utilities in trench or foundation perimeter drainage.

E. Maintain optimum moisture content of fill materials to attain required compaction density.

F. Do not leave more than 50 feet of trench open at end of working day.

G. Protect open trench to prevent danger to the public.

3.9 DISPOSAL OF EXCESS MATERIAL

A. Dispose of excess material offsite and legally.

B. Furnish Engineer with certificate of disposal site or agreement from private property owner.

3.10 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Top Surface of Backfilling: Plus or minus 1 inch from required elevations.

3.11 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Perform laboratory material tests in accordance with ASTM D1557 or AASHTO T180.

C. Perform in place compaction tests in accordance with the following:
1. Density Tests: ASTM D1556, ASTM D2167, or ASTM D2922.
2. Moisture Tests: ASTM D3017.

D. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.

E. Frequency of Tests: Two tests per lift for every 1000 feet of trench.

3.12 PROTECTION OF FINISHED WORK

A. Reshape and re-compact fills subjected to vehicular traffic during construction.

3.13 SCHEDULE OF COMPACTION

A. Under Pavement and Slabs:
   1. Granular Fill in maximum 8-inch loose lifts.
   2. Compact to minimum 95 percent maximum density except the top 12 inches.
   3. Compact top 12 inches to minimum 98 percent maximum density.

B. Under Landscape Areas:
   1. Subsoil Fill in maximum 8-inch loose lifts.
   2. Compact to minimum 90 percent maximum density.

C. In Unstable or Unsuitable Trench Foundation Areas:
   1. Foundation Stone in maximum 12-inch loose lifts.
   2. Compact to 98 percent maximum density.

END OF SECTION

SECTION 31 25 13
EROSION CONTROLS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes installing, maintaining and removing:
   1. Silt Fence.
   2. Temporary Construction Entrances.
   3. Diversion Channels.
   4. Sediment Traps.
   5. Rip Rap.
   6. Stone Check Dams.
   7. Inlet Protection.
   8. Site Stabilization.

B. Related Sections:
   1. Section 31 10 00 - Site Clearing.
   2. Section 31 23 16 - Excavation and Fill.
   3. Section 31 37 00 - Riprap.
   4. Section 32 91 19 - Landscape Grading.
   5. Section 32 92 19 - Seeding and Soil Supplements.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:
   1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-pound) rammer and a 457-mm (18-inch) drop.

B. ASTM International:
   1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).
   2. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
   3. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
   4. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

C. SCDOT Standard Specifications:
   1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data on geotextile, posts, woven wire, concrete mix design, and pipe.

C. Manufacturer's Certificate: Certify products and aggregates meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Standard of quality shall conform to the standards and practices set forth in: "South Carolina Storm water Management and Sedimentation Control Handbook for Land Disturbance Activities", February 1998 or latest edition.

B. Maintain one copy of document on site.

1.5 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this Section.

PART 2 PRODUCTS

2.1 GEOTEXTILE MATERIALS

A. Engineering Fabric Materials: Non-biodegradable conforming to Section 815.02 of SCDOT Standard Specifications:
1. Silt Fence: Type 3, Class A or B Engineering Fabric.
2. Under Rip Rap or Construction Entrances: Type 2 Engineering Fabric.

2.2 STONE, AGGREGATE, AND SOIL MATERIALS

A. Stone for Sediment Trap and Check Dam: Class B erosion control stone conforming to Division 800 of the SCDOT Standard Specifications. Minimum size 5 inches, midrange size 8 inches, and maximum size 12 inches equally distributed.

B. Stone for Rip Rap: Class 1 erosion control stone conforming to Division 800 of the SCDOT Standard Specifications. Minimum size 5 inches, midrange size 10 inches, and maximum size 17 inches equally distributed.

C. Washed Stone: Coarse aggregate, Gradation No. 57 conforming to Division 800 of the SCDOT Standard Specifications.

D. Aggregate for Construction Entrance: Coarse aggregate, Gradation No. 4 or larger with maximum size of 3 inch, conforming to Division 800 of the SCDOT Specifications.

E. Soil Fill: Clean natural soil with a plasticity index of 15 or less that is free of clay, rock, or gravel lumps larger than 2 inches in any dimension; debris; waste; frozen material; and any other deleterious material that might cause settlement. Suitable material excavated from the site may be used as soil fill under optimum moisture conditions.

2.3 PLANTING MATERIALS

A. General: Conform to South Carolina rules and regulations as specified in Section 810 of the SCDOT Standard Specifications for seed, agricultural ground limestone, fertilizers, and mulch.

B. Temporary Seed Mixture:
   1. Late winter and early spring: Rye and Annual Lespedeza (Kobe)
   2. Summer: German Millet.
   3. Fall: Rye.

C. Fertilizer: Commercial grade; recommended for grass.

D. Lime: ASTM C602, Class O agricultural ground limestone containing a minimum 80 percent calcium carbonate equivalent.

E. Mulch: Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.

2.4 CONCRETE

A. Concrete: Class B concrete conforming to Section 701 of the SCDOT Standard Specifications.
   1. Compressive strength of 2,500 psi at 28 days.
   2. Air entrained.
   3. Water cement ratio of 0.488 with rounded aggregate and 0.567 with angular aggregate.
   4. Maximum slump of 2.5 inches for vibrated concrete and 4 inches for non-vibrated concrete.
   5. Minimum cement content of 508 lbs per cubic yard for vibrated and 545 lbs per cubic yard for non-vibrated concrete.

2.5 PIPE MATERIALS

A. Pipe: Corrugated steel pipe and fittings conforming to Section 715.2.3 of SCDOT Standard Specifications.

2.6 ACCESSORIES

A. Posts for Silt Fence and Inlet Protection: Steel posts 5 feet long, 1-3/8 inches wide, minimum weight 1.25 lbs/ft. conforming to Section 815.4.6 of the SCDOT Standard Specifications.

B. Woven Wire Fence for Silt Fence: Minimum 32 inches high, minimum 5 horizontal wires, vertical wires spaced 12 inches apart, minimum 10 gage top and bottom wires, and minimum 12-1/2 gage; all other wires conforming to Section 815 of the SCDOT Standard Specifications.

C. Attachment Devices for Silt Fence: No. 9 staple, minimum 1-1/2 inches long, or other approved attachment devices.

D. Hardware Cloth for Inlet Protection: 24 gage, 1/4-inch mesh opening hardware cloth.

E. Trash Rack for Pipe Riser: Cone shaped with #4 bars welded at each intersection of bars and sized to fit pipe riser. Conform to Division 800 of the SCDOT Standard Specifications.

2.7 SOURCE QUALITY CONTROL (AND TESTS)

A. Section 01 40 00 - Quality Requirements: Testing, inspection, and analysis requirements.

B. Perform tests on cement, aggregates, and mixes to ensure conformance with specified requirements.

C. Make rock available for inspection at producer's quarry prior to shipment. Notify Architect/Engineer at least seven days before inspection is allowed.

D. Allow witnessing of inspections and tests at manufacturer's test facility. Notify Architect/Engineer at least seven days before inspections and tests are scheduled.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify compacted subgrade is acceptable and ready to support devices and imposed loads.

C. Verify gradients and elevations of base or foundation for other work are correct.

3.2 SILT FENCE

A. Install in accordance with Section 815 of the SCDOT Standard Specifications at locations shown on Drawings.

B. Use wire fence with Class A fabric.

C. Class B fabric may be used without woven wire backing subject to the following:
1. Fabric is approved by Architect/Engineer.
2. Maximum post spacing is 6 feet.
3. Posts are inclined toward runoff source not more than 20 degrees from vertical.

3.3 TEMPORARY CONSTRUCTION ENTRANCES

A. Excavate and compact subgrade as specified in Section 31 23 16.

B. Install construction entrances to the dimensions and locations as shown on Drawings. Minimum thickness is 6 inches.

C. Mound aggregate near intersection with public road to prevent site runoff entering road.

D. Periodically dress entrances with 2-inch thick course aggregate when aggregate becomes clogged with soil.

3.4 DIVERSION CHANNELS

A. Excavate channel as specified in Section 31 23 16.

B. Windrow excavated material on low side of channel.

C. Compact to 95 percent maximum density.

D. On entire channel area, apply soil supplements and sow seed as specified in Section 32 92 19.

E. Mulch seeded areas with hay as specified in Section 32 92 19.

3.5 SEDIMENT TRAPS

A. Clear site as specified in Section 31 00 00.

B. Construct trap by excavating and forming embankments as specified in Section 31 23 16.

C. Place coarse aggregate or rock at outlet as indicated on Drawings.

D. Place geotextile fabric as specified for rock lining.

E. On entire sediment trap area, apply soil supplements and sow seed as specified in Section 32 92 19.

F. Mulch seeded areas with hay as specified in Section 32 92 19.

G. Clean trap of accumulated sediment when directed but no less than when trap is half full of sediment.

3.6 ROCK LINING (RIP RAP)

A. Excavate to depth of rock lining as indicated on Drawings or nominal placement thickness as follows. Remove loose, unsuitable material below bottom of rock lining and replace with suitable material. Thoroughly compact and finish entire foundation area to firm, even surface.

B. Lay and overlay geotextile fabric over substrate. Lay fabric parallel to flow from upstream to downstream. Overlap edges upstream over downstream and upslope over downslope. Provide a minimum overlap of 3 feet. Offset adjacent roll ends a minimum of 5 feet when lapped. Cover fabric as soon as possible and in no case leave fabric exposed more than 4 weeks.

C. Carefully place rock on geotextile fabric to produce an even distribution of pieces with minimum of voids and without tearing geotextile.

D. Unless indicated otherwise, place full course thickness in one operation to prevent segregation and avoid displacement of underlying material. Arrange individual rocks for uniform distribution.

3.7 STONE CHECK DAM

A. Determine length required for ditch or depression slope and excavate, backfill, and compact foundation area to firm, even surface.

B. Place Class B erosion control stone in an even distribution of rock pieces with minimum voids to the indicated shape, height, and slope.

C. Construct washed stone filter blanket against upstream face of stone heck dam to the thickness indicated on Drawings.

3.8 INLET PROTECTION

A. Install four posts around drainage structure and attach hardware cloth as indicated on Drawings.

B. Place Class B erosion control stone at base of fabric and mound at approximately 2:1.

C. Place washed stone filter blanket on upstream side(s).

3.9 SITE STABILIZATION

A. Incorporate erosion control devices indicated on the Drawings into the Project at the earliest practicable time.

B. Construct, stabilize, and activate erosion controls before site disturbance within tributary areas of those controls.

C. Stockpile and waste pile heights shall not exceed 35 feet. Slope stockpile sides at 2:1 or flatter.

D. Stabilize any disturbed area of affected erosion control devices on which activity has ceased and which will remain exposed for more than 20 days.
   1. During non-germinating periods, apply mulch at recommended rates.
   2. Stabilize disturbed areas which are not at finished grade and which will be disturbed within one year in accordance with Section 32 92 19 at 75 percent of permanent application rate with no topsoil.
   3. Stabilize disturbed areas which are either at finished grade or will not be disturbed within one year in accordance with Section 32 92 19 permanent seeding specifications.

E. Stabilize diversion channels, sediment traps, and stockpiles immediately.

3.10 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect erosion control devices on a weekly basis and after each runoff event. Make necessary repairs to ensure erosion and sediment controls are in good working order.

C. Perform laboratory material tests in accordance with ASTM D1557 or AASHTO T180.

D. Perform in place compaction tests in accordance with the following:
1. Density Tests: ASTM D1556, ASTM D2167, or ASTM D2922.
2. Moisture Tests: ASTM D3017.

E. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

F. Frequency of Tests: Twice per lift for every 10,000 square feet.

3.11 CLEANING

A. When sediment accumulation in sedimentation structures has reached a point one-half depth of sediment structure or device, remove and dispose of sediment.

B. Do not damage structure or device during cleaning operations.

C. Do not permit sediment to erode into construction or site areas or natural waterways.
D. Clean channels when depth of sediment reaches approximately one-half channel depth.

3.12 SCHEDULES

A. Erosion Control Schedule:

Erosion Control Element	Location	Size
Silt Fence		
Temporary Construction Entrance		
Diversion Channel		
Sediment Trap		
Rock Lining (Rip Rap)		
Stone Check Dams		
Inlet Protection		
Sediment Pond		

END OF SECTION

SECTION 313116 - TERMITE CONTROL

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. Soil treatment.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood preservative treatment by pressure process.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components, and profiles for termite control products.
2. Include the EPA-Registered Label for termiticide products.

B. Sustainability Submittals
1. Environmental Product Declaration: For each product.
2. Occupant Exposure Screening Report (OESR) Prepared in accordance with ASTM E3182-20

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.
B. Product Certificates: For each type of termite control product.
C. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:

1. Date and time of application.
2. Moisture content of soil before application.
3. Termiticide brand name and manufacturer.

4. Quantity of undiluted termiticide used.
5. Dilutions, methods, volumes used, and rates of application.
6. Areas of application.
7. Water source for application.

D. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located and who employs workers trained and approved by manufacturer to install manufacturer's products.

1.6 FIELD CONDITIONS

A. Soil Treatment:

1. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.
2. Related Work: Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

1.7 WARRANTY

A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work consisting of applied soil termiticide treatment will prevent infestation of subterranean termites, including Formosan termites (Coptotermes formosanus). If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain termite control products from single source.

2.2 SOIL TREATMENT

A. Termiticide: EPA-Registered termiticide acceptable to authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation.

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. Bayer Environmental Science.
    b. Ensystex, Inc.
    c. Master Builders Solutions; brand of MBCC Group.
    d. Syngenta Crop Protection, LLC.

2. Service Life of Treatment: Soil treatment termiticide that is effective for not less than five years against infestation of subterranean termites.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.
B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Prepare work areas according to the requirements of authorities having jurisdiction and according to manufacturer's written instructions before beginning application and installation of termite control treatment(s). Remove extraneous sources of wood cellulose and other edible materials, such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.
B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.

    1. Fit filling hose connected to water source at the site with a backflow preventer, according to requirements of authorities having jurisdiction.

3.3 APPLYING SOIL TREATMENT

A. Application: Mix soil treatment termiticide solution to a uniform consistency. Distribute treatment uniformly. Apply treatment at the product's EPA-Registered Label volume and rate for maximum specified concentration of termiticide to the following so that a continuous

horizontal and vertical termiticidal barrier or treated zone is established around and under building construction.

1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
2. Foundations: Soil adjacent to and along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing.
3. Penetrations: At expansion joints, control joints, and areas where slabs and below-grade walls will be penetrated.

B. Post warning signs in areas of application.
C. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

3.4 PROTECTION

A. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.
B. Protect termiticide solution dispersed in treated soils and fills from being diluted by exposure to water spillage or weather until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

END OF SECTION 313116

SECTION 32 11 23
AGGREGATE BASE COURSES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Aggregate base course on a prepared subgrade.

B. Related Sections:
   1. Section 31 23 16 - Excavation and Fill: Preparing subgrade under base course.
   2. Section 32 12 16 - Asphalt Paving: Binder and finish asphalt courses.
   3. Section 32 13 13 - Concrete Paving: Finish concrete surface course.
   4. Section 32 17 13 - Parking Bumpers.
   5. Section 33 05 13 - Manholes and Structures: Frames and lids penetrating aggregate base course.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:
   1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-pound) rammer and a 457-mm (18-inch) drop.

B. ASTM International:
   1. [ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).]
   2. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
   3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
   4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
   5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
   6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

C. SCDOT Standard Specifications:
   1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Samples: Submit to testing laboratory 10-pound sample of each type of aggregate in airtight containers.

C. Materials Source: Submit name of imported materials suppliers.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with Divisions 300 and 800 of the SCDOT Standard Specifications.

B. Maintain one copy of document on site.

C. Furnish each aggregate material from single source throughout the Work.

D. Use sources approved by SCDOT.

PART 2 PRODUCTS

2.1 MATERIALS

A. Aggregate Base Course: Coarse aggregate Type A or B with a gradation of ABC conforming to Section 801 of SCDOT Standard Specifications.

B. Fine Aggregate: Sand gradation 1S or 2S conforming to Section 801 of SCDOT standard Specifications.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verify existing conditions before starting work.

B. Verify substrate has been inspected and gradients and elevations are correct and dry.

3.2 PREPARATION

A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and recompacting as specified in Section 31 23 16.

B. Do not place fill on soft, muddy, or frozen surfaces.

3.3 AGGREGATE PLACEMENT

A. Place aggregate in minimum 4-inch and maximum 10-inch layers and roller compact to specified density. When total thickness is 10 inches or less, place in one layer. When total thickness is greater than 10 inches, place in two equal layers.

B. Have each layer of material compacted and approved prior to placing succeeding layers.

C. Level and contour surfaces to elevations and gradients indicated on Drawings.

D. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.

E. Maintain optimum moisture content of fill materials to attain required compaction density.

F. Use mechanical tamping equipment in areas inaccessible to roller compaction equipment.

3.4 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Variation from Thickness: 1/2 inch.

C. Maximum Variation from Elevation: 1/2 inch.

3.5 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Independent laboratory, field inspecting, testing, adjusting, and balancing.

B. Laboratory Material Tests: Conform to Modified Proctor ASTM D1557 or AASHTO T180.

C. In-place Compaction Tests: Conform to:
1. Density Tests: ASTM D1556, ASTM D2167, or ASTM D2922.
2. Moisture Tests: ASTM D3017.

D. Compaction:
1. 100 percent of maximum when measured in-place by standard methods.
2. 98 percent of maximum when measured in-place by nuclear methods.

E. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

F. Frequency of Compaction Tests: Two tests per layer for every 5,000 tons of aggregate base course.

END OF SECTION

SECTION 32 12 16
ASPHALT PAVING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Asphaltic Concrete Paving: Surface, binder, and base courses.
2. Prime Coat and Tack Coat.
3. Surface Sealer.
4. Quality Control and Testing.

B. Related Sections:
1. Section 31 23 16 - Excavation and Fill: Compacted subbase for paving.
2. Section 32 11 23 - Aggregate Base Courses: Compacted base for paving.
3. Section 32 13 13 - Concrete Paving: Concrete curbs.
4. Section 32 17 23 - Pavement Markings.
5. Section 33 05 13 - Manholes and Structures: Frames and lids in pavement.

1.2 REFERENCES

A. SCDOT Standard Specifications:
1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit product information and mix design.

C. Manufacturer's Certification: Certify products are produced at a plant approved by SCDOT and that products meet or exceed specified requirements.

D. Installer Certification: Certify installer is on list of SCDOT approved contractors with an approved Quality Control Plan.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with Division 400 of SCDOT Standard Specifications.

B. Maintain on site one copy of each document.

C. Obtain materials from same source throughout.

D. Installer Qualification: Company specializing in performing work of this Section with minimum 5 years experience.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Do not place asphalt base course or intermediate course when ambient air or road surface temperature is less than 35 degrees F. or surface is wet or frozen.

B. Do not place asphalt surface course when ambient air or road surface temperature is less that 50 degrees F. or wet.

C. Place bitumen mixture when temperature is not more than 15 degrees F. below temperature at when initially mixed and not more than maximum specified temperature.

PART 2 PRODUCTS

2.1 MATERIALS

A. Asphalt Plant Mix Materials: Conform to Division 400 of SCDOT Standard Specifications.

B. Prime Coat and Tack Coat: Conform to Division 400 of SCDOT Standard Specifications.

C. Reclaimed Asphalt Pavement (RAP): Processed material obtained by milling or full depth removal of existing asphalt concrete pavements. Conform to Division 400 of SCDOT Standard Specifications.

D. Sand: Fine aggregate, gradation S1 or S2 conforming to Divisions 300 and 400 of SCDOT Standard Specifications.

2.2 ASPHALT PAVING MIX

A. General: Use Superpave mix design conforming to Division 400 of SCDOT Standard Specifications.

B. Wedging or Leveling Mix: Conform to intermediate course.

C. Reclaimed Asphalt Pavement (RAP) Content: Use maximum 50 percent for base and intermediate courses, maximum 15 percent for surface course.

2.3 SOURCE QUALITY CONTROL AND TESTS

A. Section 00 14 00 - Quality Requirements: Testing, inspection, and analysis requirements.

B. Submit proposed mix design of each class of mix for review prior to beginning Work.

C. Obtain materials from plant approved by SCDOT.

D. Test plant samples in accordance with Division 400 of SCDOT Standard Specifications.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify compacted subgrade and aggregate base is dry and ready to support paving and imposed loads.

B. Verify gradients and elevations of base are correct.

C. Verify utility structure frames and lids are installed in correct position and elevation.

3.2 PRIME COAT

A. Apply primer on aggregate base course at uniform rate of 0.2 to 0.5 gal/sq. yd. in accordance with Division 400 of SCDOT Standard Specifications.

B. Apply primer to contact surfaces of curbs and gutters.

C. Use clean sand to blot excess primer.

3.3 TACK COAT

A. Apply tack coat on asphalt or concrete surfaces at uniform rate of 0.04 to 0.08 gallons/square yard in accordance with Division 400 of SCDOT Standard Specifications.

B. Apply tack coat to contact surfaces of curbs and gutters.

C. Coat surfaces of utility structures with oil to prevent bond with asphalt pavement. Do not tack-coat these surfaces.

3.4 PLACING ASPHALT PAVEMENT

A. Install Work in accordance with Division 400 of SCDOT Standard Specifications.

B. Place asphalt within 24 hours of applying prime coat or tack coat.

C. Place asphalt in courses to the thicknesses and dimensions shown on the Drawings.

D. Place binder and intermediate courses.

E. Place surface course within 2 hours of placing and compacting binder course. When binder course is placed more than 24 hours before placing wearing course, clean surface and apply tack coat before placing wearing course.

F. Place surface course to thicknesses and dimensions shown on the Drawings.

G. Compact each course by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.

H. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

3.5 JOINTS

A. Traverse Joints:
1. When Work is suspended long enough to allow mixture to chill, construct transverse joint.
2. Use butt joint when traffic will not pass over pavement.
3. Use sloped wedge ahead of the end of pavement when traffic will pass over pavement. Place paper parting strip to removal of wedge.
4. Tack coat edge of pavement prior to placing adjoining pavement.

B. Longitudinal Joints:
1. Tack the edge of longitudinal joints prior to placing adjoining pavement.
2. Pinch joint by rolling immediately behind the paver.
3. Offset longitudinal joints in each layer by approximately 6 inches.

3.6 TOLERANCES

A. Density Compaction: Minimum of 92 percent of Maximum Specific Gravity (G_{mm}).

B. Flatness: Maximum variation of 1/8-inch measured with 10-foot straight edge.

C. Compacted Thickness: Within 1/4-inch.

D. Variation From Indicated Elevation: Within 1/2-inch.

3.7 FIELD QUALITY CONTROL

A. Section 00 14 00 - Quality Requirements: Independent testing firm, field testing, and inspecting.

B. Perform Contractor Quality Control Program in accordance with Division 400 of SCDOT Standard Specifications.

C. Take compaction tests every 2,000 linear feet or fraction thereof per day on pavement placed at the paver lay down width.

D. Take 6-inch diameter full depth pavement cores every 2,000 linear feet or fraction thereof per day on pavement placed at the paver lay down width.

E. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

3.8 PROTECTION OF FINISHED WORK

A. Immediately after placement, protect pavement from mechanical injury for seven days or until surface temperature is less than 140 degrees F.

END OF SECTION

SECTION 32 13 13
CONCRETE PAVING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Concrete sidewalks.
2. Concrete integral curbs and gutters.
3. Concrete median barriers.
4. Concrete base and surface for parking areas and roads.
5. Small miscellaneous slabs.

B. Related Sections:
1. Section 31 23 23 - Excavation and Fill: Compacted subgrade for paving.
2. Section 32 11 23 - Aggregate Base Courses: Compacted base for paving.
3. Section 32 12 16 - Asphalt Paving: Asphalt wearing course.
4. Section 32 17 23 - Pavement Markings.
5. Section 33 05 13 - Manholes and Structures: Frames and lids in paving.

1.2 REFERENCES

A. American Association of State Highway Transportation Officials (AASHTO)
1. AASHTO M 31 - Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.
2. AASHTO M 32 - Steel Wire, Plain for Concrete Reinforcement.
3. AASHTO M 282 - Joint Sealants, Hot Poured, Elastomeric-Type, for Portland Cement Concrete Pavements.

B. American Concrete Institute:
1. ACI 301 - Specifications for Structural Concrete.
2. ACI 304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete.

C. ASTM International:
1. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
2. ASTM A 497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
3. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
4. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
5. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
6. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

D. SCDOT Standard Specifications:
   1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Concrete Mix Design: Submit concrete mix design 30 days prior to use of concrete.

C. Product Data: Submit data on joint materials, admixtures, and curing compounds.

D. Manufacturer's Certification: Certify products are produced at a plant approved by SCDOT and that products meet or exceed specified requirements.

E. Installer Certification: Certify installer is on list of SCDOT prequalified contractors with an approved Quality Control Plan.

F. Process Control Plan: Submit process control plan for delivering and placing concrete.

G. Samples: Submit two sample panels, 2 inch x 12 inch in size, illustrating exposed aggregate finish.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with section 501 of SCDOT Standard Specifications, except as modified herein.

B. Maintain one copy of document on site.

C. Obtain cementitious materials from same source throughout.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section and prequalified by SCDOT.

B. Installer: Company specializing in performing Work of this Section and prequalified by SCDOT.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

B. Do not place concrete when base surface temperature or air temperature in the shade is 40 degrees F and falling or surface is wet or frozen.

C. Do not place concrete when air temperature in the shade is 95 degrees F and rising or when concrete temperature is greater than 95 degrees F.

PART 2 PRODUCTS

2.1 FORM MATERIALS

A. Slip Form Methods: Use slip form methods wherever possible.

B. Fixed Form Materials: Metal conforming to Section 501 of SCDOT Standard Specifications.

2.2 JOINT MATERIALS

A. General: Conform to Section 501 of SCDOT Standard Specifications.

B. Joint Filler: Sponge rubber or cork type conforming to ASTM D1751 (AASHTO M213) or bituminous, non-extruding, resilient type conforming to ASTM D1752 (AASHTO M153), Type 1; thickness as indicated on Drawings.

C. Silicone Sealant: Low modulus, cold applied, single component, chemically curing silicone material.
1. Type NS: Non-sag silicone, toolable.
2. Type SL: Self-leveling silicone, tooling not required.

D. Rubber Asphalt Sealant: Hot poured rubber asphalt joint sealer conforming to AASHTO M282 (ASTM D3406).

E. Bond Breaker:
1. General: Product that does not stain or adhere to the sealant and is chemically inert and resistant to oils, gasoline, solvents, and primer.
2. For On-Grade Pavements: Circular backer rod, diameter 25 percent larger than joint width.
   a. Type L, For Cold Pour Sealants Only: Closed cell expanded polyethylene foam. Use with Type NS silicone only.
   b. Type M, For Cold or Hot Pour Sealants: Closed cell polyolefin with closed skin over an open cell core.
3. For Bridge Decks Only: Bond breaking tape, extruded polyethylene with pressure sensitive adhesive on one side, minimum 0.005 inches thick.

2.3 REINFORCEMENT

A. General: Conform to Section 501 of SCDOT Standard Specifications.

B. Reinforcing Steel: ASTM A615 (AASHTO M 31); 60 ksi yield grade; deformed billet steel bars; epoxy coated finish.

C. Dowels and Tie Bars: ASTM A615 (AASHTO M 31); 60 ksi yield grade, plain steel,

epoxy coated finish.

D. Welded Wire Fabric Steel: Deformed type, ASTM A497; unfinished.

2.4 CONCRETE MATERIALS

A. Concrete Materials: Provide fine aggregate, coarse aggregate, Portland Cement, fly ash, ground granulated blast furnace slag, water, air entraining agent, and chemical admixtures in accordance with Section 501 of SCDOT Standard Specifications.

2.5 ACCESSORIES

A. Curing Compound: ASTM C309 (AASHTO M-148), Type 1 clear or translucent or Type 2 white pigmented.

2.6 CONCRETE MIX

A. Mix and deliver concrete in accordance with Section 501 of SCDOT Standard Specifications.

B. Roadway and Area Pavement concrete: Air entrained conforming to the following criteria:
1. Flexural Strength: 650 psi at 28 days.
2. Slump: 1.5 inch maximum for slip form method, 3 inches maximum for fixed form hand methods.
3. Minimum Cement Content: 526 pounds/cubic yard.
4. Maximum Water/Cement Ratio: 0.559.
5. Air Entrainment: Between 4.5 and 5.5 percent.

C. Class A Concrete for sidewalk, curb, curb and gutter, and other incidental site concrete: Air entrained, vibrated conforming to the following criteria:
1. Compressive Strength: 3,000 psi at 28 days.
2. Maximum Slump Vibrated: 3.5 inches.
3. Minimum Cement Content: 564 pounds/cubic yard.
4. Maximum Water/Cement Ratio for Angular Aggregate: 0.532.
5. Maximum Water/Cement Ratio for Rounded Aggregate: 0.488.
6. Air Entrainment: 6.0 percent plus or minus 1.5 percent.

D. Use accelerating admixtures in cold weather only when approved by the Engineer in writing. Use of admixtures will not relax cold weather placement requirements.

E. Use calcium chloride only when approved by the Engineer in writing.

F. Use set retarding admixtures during hot weather only when approved by the Engineer in writing.

2.7 SOURCE QUALITY CONTROL AND TESTS

A. Section 01 40 00 - Quality Requirements: Testing and Inspection Services.

B. Submit proposed mix design of each class of concrete to independent firm for review prior to commencement of Work.

C. Tests on cement, aggregates, and mixes will be performed to ensure conformance with specified requirements.

D. Test samples in accordance with ACI 301 for compressive strength (cylinders) and flexural strength (beams.)

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify compacted base course is acceptable and ready to support paving and imposed loads.

C. Verify gradients and elevations of base are correct.

D. Verify utility structure frames and lids are installed in correct position and elevation.

3.2 PREPARATION

A. Moisten base to minimize absorption of water from fresh concrete.

B. Coat surfaces of manhole, catch basin, and other utility structure frames with oil to prevent bond with concrete pavement.

C. Notify Engineer minimum 24 hours prior to commencement of concreting operations.

3.3 FORMING

A. Place and secure forms to correct location, dimension, profile, and gradient.

B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.

C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.4 REINFORCEMENT

A. Place reinforcement as indicated on Drawings.

B. Interrupt reinforcement at contraction and expansion joints.

C. Place dowels to achieve pavement and curb alignment as detailed.

D. Provide doweled joints 18 inches on center at transverse joints with one end of dowel set in capped sleeve to allow longitudinal movement.

3.5 PLACING CONCRETE

A. Place concrete in accordance with Section 501 of SCDOT Standard Specifications.

B. Place concrete using the slip form technique wherever possible.

C. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed during concrete placement.

D. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.

E. Place concrete to pattern indicated on Drawings.

3.6 PAVEMENT JOINTS

A. Provide expansion, contraction, and construction joints as indicated on Drawings.

B. Place expansion joints at 60 foot maximum intervals. Place contraction joins at 20-foot maximum intervals. Align pavement joints with curb, gutter, and sidewalk joints.

C. Place joint filler between paving components and building or other appurtenances. Recess top of filler 1/2 inch for backer rod and sealant placement.

D. Saw cut contraction joints 3/16 inch wide or as indicated at an optimum time after finishing. Cut 1/3 into depth of slab.

3.7 SIDEWALK, CURB, AND CURB AND GUTTER JOINTS

A. Provide sawn joints at 5-foot intervals. Provide 3/4 inch expansion joint at 30 feet maximum and between sidewalks and curbs and structures.

B. Align sidewalk, curb and gutter joints with pavement joints.

3.8 FINISHING

A. Area Paving: Heavy broom.

B. Sidewalk Paving: Light broom. [Brush to 6 inch radius with smooth trowel joint edges.]

C. Median Barrier: Light broom and trowel joint edges.

D. Curbs and Gutters: Light broom.

E. Inclined Vehicular Ramps: V-grooves with mechanical equipment and spring tines, perpendicular to slope.

3.9 EXPOSED AGGREGATE

A. Apply surface retarder where exposed aggregate finish is indicated.

B. Wash exposed aggregate surface with clean water and scrub with stiff bristle brush exposing aggregate to match sample panel.

C. Sand blast concrete surfaces to achieve aggregate exposure surface to match sample panel.

3.10 CURING

A. Place curing compound on concrete surfaces immediately after finishing.

B. Cover with burlap or polyethylene film to protect from cold weather and rain.

3.11 JOINT SEALING

A. Separate pavement from vertical surfaces with 1/2 inch thick joint filler.

B. Place joint filler in pavement pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.

C. Extend joint filler from bottom of pavement to within 1/2 inch of finished surface.

3.12 TOLERANCES

A. Maximum Variation of Surface Flatness: 1/4 inch in 10 feet.

B. Maximum Variation From True Position: 1/2 inch.

C. Maximum Variation in thickness: 1/2 inch.

3.13 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Prepare three concrete test beams for every 1,333 or less square yards of pavement for each class of concrete placed each day.

C. Prepare one additional test beam during cold weather and cured on site under

same conditions as concrete it represents.

D. One slump test will be taken for each set of test cylinders taken.

E. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

F. Take one 4-inch diameter core for every 1,333 square yards or less of pavement for each class of concrete placed each day.

3.14 PROTECTION

A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.

B. Do not permit pedestrian or vehicular traffic over pavement for 7 days minimum after finishing.

3.15 SCHEDULES

A. Concrete Sidewalks: Class A Concrete, compressive strength of 3,000 psi at 28 days, 4 inches thick, buff color Portland cement, light broom finish.

B. Roadway Pavement Concrete: Non-reinforced, flexural strength of 650 psi at 28 days, 8 inches thick, wood float finish.

C. Propane Tank Slab: Class AA Concrete, 4,500 psi 28 day concrete, 6 inches thick, 6/6-6 x 6 inch mesh reinforcement, light broom finish.

END OF SECTION

SECTION 321400 - UNIT PAVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Concrete pavers set on concrete slab.
2. Concrete pavers set in aggregate setting bed.
3. Edge restraints for unit pavers.

B. Related Sections include the following:

1. Division 3 – Site Concrete for cast-in-place concrete curbs and gutters serving as edge restraint for unit pavers.

1.3 SUBMITTALS

A. Product Data: For the following:
1. Concrete pavers.
2. Edge restraints.

B. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of unit paver indicated.

1. Include similar Samples of material for joints and accessories involving color selection.

C. Samples for Verification: Full-size units of each type of unit paver indicated; in sets for each color, texture, and pattern specified, showing the full range of variations expected in these characteristics.

1. Provide Samples with joints grouted and cured, showing the full range of colors to be expected in the completed Work.
2. Include Samples of exposed edge restraints.

D. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed unit paver installations similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Source Limitations: Obtain each type of unit paver, joint material, and setting material from one source with resources to provide materials and products of consistent quality in appearance and physical properties.

C. Mockups: Before installing unit pavers, build mockups for each form and pattern of unit pavers required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Multiple Mock Ups may be required. Build mockups to comply with the following requirements, using materials indicated for the completed Work, including same base construction, special features for expansion joints, and contiguous work as indicated:

1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Architect's approval of mockups before starting unit paver installation.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed.
7. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect unit pavers and aggregate during storage and construction against soiling or contamination from earth and other materials.

1. Cover pavers with plastic or use other packaging materials that will prevent rust marks from steel strapping.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store liquids in tightly closed containers protected from freezing.

D. Store asphalt cement and other bituminous materials in tightly closed containers.

1.6 PROJECT CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. 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:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Concrete Pavers:

A. Traditional® Prest® Brick | Hanover® Architectural Products (hanoverpavers.com)
B. Belgard

2. Steel Edge Restraints:

a. Border Concepts, Inc.
b. Ryerson: J. T. Ryerson & Son, Inc.

3. Aluminum Edge Restraints:

a. BrickStop Corporation.
b. Permaloc Corporation.
c. Sure-loc Aluminum Edging.

4. Latex-Portland Cement Mortars and Grouts:

a. American Olean Tile Co.
b. Boiardi Products Corp.
c. Bonsal: W. R. Bonsal Company.
a. Bostik.
b. Dal-Tile Corporation.
c. Laticrete International, Inc.
d. Mapei Corp.
e. Or approved equal.

2.2 COLORS AND TEXTURES

A. Colors and Textures: **As selected by Architect from manufacturer's full range**.

2.3 UNIT PAVERS

A. Concrete Pavers: Solid, interlocking paving units, ASTM C 936, made from normal-weight aggregates in sizes and shapes indicated.

2.4 ACCESSORIES

A. Aluminum Edge Restraints: Extruded-aluminum edging with loops pressed from face to receive stakes at 12 inches o.c., and aluminum stakes 12 inches (300 mm) long for each loop. Type and size of edging is as follows:

1. Straight, 3/16 inch (4.8 mm) thick by 4 inches (100 mm) high.
2. L-shaped, 3/16 inch (4.8 mm) thick by 2-1/4 inches (57 mm) high.

B. Precast Concrete Edge Restraints: Precast concrete curbing, made from normal-weight aggregate, in shapes and sizes indicated. Edge restrainght to have Oyster shell finish.

C. Job-Built Concrete Edge Restraints: Comply with requirements in Division 3 Section "Site Concrete" for normal-weight, air-entrained, ready-mixed concrete with minimum 28-day compressive strength of 3000 psi (20 MPa).

2.5 AGGREGATE SETTING-BED MATERIALS

A. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements of ASTM C 33 for fine aggregate.

B. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 (1.18-mm) sieve and no more than 10 percent passing No. 200 (0.075-mm) sieve.

1. Provide sand of color needed to produce required joint color.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas indicated to receive paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Vacuum clean concrete substrates to remove dirt, dust, debris, and loose particles.

B. Remove substances, from concrete substrates, that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.

C. Proof-roll prepared subgrade surface to check for unstable areas and areas requiring additional compaction. Proceed with unit paver installation only after deficient subgrades have been corrected and are ready to receive subbase for unit pavers.

3.3 INSTALLATION, GENERAL

FINAL PAVER INSTALLATION MUST BE ADA COMPLIANT

A. Do not use unit pavers with chips, cracks, voids, discolorations, and other defects that might be visible or cause staining in finished work.

B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.

1. For concrete pavers, a block splitter may be used.

D. Joint Pattern: As directed by Architect

1. Provide joint filler, where indicated, at waterproofing that is turned up on vertical surfaces; or, if not indicated, provide temporary filler or protection until paver installation is complete.

E. Tolerances: Do not exceed 1/32-inch (0.8-mm) unit-to-unit offset from flush (lippage) nor 1/8 inch in 10 feet (3 mm in 3 m) from level, or indicated slope, for finished surface of paving.

F. Tolerances: Do not exceed 1/16-inch (1.6-mm) unit-to-unit offset from flush (lippage) nor 1/8 inch in 24 inches (3 mm in 600 mm) and 1/4 inch in 10 feet (6 mm in 3 m) from level, or indicated slope, for finished surface of paving.

G. Expansion and Control Joints: Provide for sealant-filled joints at locations and of widths indicated. Provide joint filler as backing for sealant-filled joints where indicated. Install joint filler before setting pavers. Sealant materials and installation are specified in Division 7 Section "Joint Sealants."

H. Expansion and Control Joints: Provide joint filler at locations and of widths indicated. Install joint filler before setting pavers. Make top of joint filler flush with top of pavers.

I. Provide edge restraints as indicated. Install edge restraints before placing unit pavers.

1. Install edge restraints to comply with manufacturer's written instructions. Install stakes at intervals required to hold edge restraints in place during and after unit paver installation.
2. For metal edge restraints with top edge exposed, drive stakes at least 1 inch (25 mm) below top edge.

3.7 REPAIR, CLEANING, AND PROTECTION

A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units as intended. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

END OF SECTION 321400

SECTION 32 17 13
PARKING BUMPERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Precast concrete parking bumpers.
   2. Parking bumper anchors.

B. Related Sections:
   1. Section 32 12 16 - Asphalt Paving.
   2. Section 32 13 13 - Concrete Paving.

1.2 REFERENCES

A. ASTM International:
   1. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit unit configuration, dimensions.

1.4 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate the Work with pavement placement and parking striping.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:
   1. Gage Brothers Concrete Products.
   2. Southern Cast Stone Co., Inc.
   3. Parking Bumper Co.
   4. Substitutions: Equal per Section 01 60 00 - Product Requirements.

2.2 CONCRETE BUMPERS

A. Precast Reinforced Concrete Mix: Minimum compressive strength of 5,000 psi at 28 days, air entrained to 5 to 7 percent.

B. Use rigid molds constructed to maintain precast units uniform in shape, size, and

finish. Maintain consistent quality during manufacture.

C. Embed reinforcing steel and drill or sleeve for two dowels.

D. Cure units to develop concrete quality and to minimize appearance blemishes including non-uniformity, staining, or surface cracking.

E. Minor patching in plant is acceptable providing appearance of units is not impaired.

2.3 CONFIGURATION

A. Nominal Size: 6 inches high, 8 inches wide, 6 feet long.

B. Profile: Manufacturer's standard cross section with sloped vertical faces, square ends, and drainage slots.

2.4 ACCESSORIES

A. Dowels: Steel, unfinished, 1/2 inch diameter, 24 inches long, pointed tip conforming to ASTM A615.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install units without damage to shape or finish. Replace or repair damaged units.

B. Install units in alignment with adjacent work.

C. Fasten units in place with two dowels for each unit bumper.

D. Core drill concrete pavement 1/8 inch larger than dowel. Seal annular space around hole with grout or sealant.

END OF SECTION

SECTION 32 17 23
PAVEMENT MARKINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Traffic lines, legends and markings on asphalt and concrete surfaces.
   2. Waterborne Traffic Paint.
   3. Thermoplastic Pavement Markings.
   4. Glass beads.

B. Related Sections:
   1. Section 32 12 16 - Asphalt Paving.
   2. Section 32 13 13 - Concrete Paving.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:
   1. AASHTO M247 - Standard Specification for Glass Beads Used in Traffic Paint.

B. SCDOT Standard Specifications:
   1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.

1.3 PERFORMANCE REQUIREMENTS

A. Paint Adhesion: Adhere to road surface forming smooth continuous film one minute after application.

B. Paint Drying: Tack free by touch so as not to require coning or other traffic control devices to prevent transfer by vehicle tires within 10 minutes after application.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit paint formulation for each type of paint and glass beads if required.

C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

D. Manufacturer's Installation Instructions: Submit instructions for application temperatures, eradication requirements, application rate, line thickness, and application of glass beads if required.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with Division 600 of SCDOT Standard Specifications.

B. Maintain one copy of document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum 5 years experience.

B. Applicator: Company specializing in performing work of this section with minimum 5 years experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Invert containers several days prior to use when paint has been stored more than two months. Minimize exposure to air when transferring paint. Seal drums and tanks when not in use.

C. Where glass beads are required, store glass beads in cool, dry place. Protect from contamination by foreign substances.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

B. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by paint product manufacturer or:
   1. Waterborne Paint: Apply when ambient air temperature and surface temperature is minimum 40 degrees F and rising and a maximum of 160 degrees F.
   2. Thermoplastic: Do not apply until ambient air temperature and temperature of the pavement is 50 degrees F or higher.

C. Do not apply materials during rain or snow when relative humidity is outside humidity ranges or moisture content of surfaces exceed those required by paint product manufacturer.

D. Volatile Organic Content (VOC). Do not exceed State or Environmental Protection Agency maximum VOC on traffic paint.

PART 2 PRODUCTS

2.1 PAINTED PAVEMENT MARKINGS

A. Manufactures:
   1. Ennis Paint Co., (ennispaint.com).
   2. Franklin Paint Company (franklinpaint.com).

3. EZ-Liner Industries (ezliner.com).
4. TAPCO, Inc. (tapconet.com).
5. Pervo Paint Company (pervo.com).
6. Substitutions: Equal per Section 01 60 00 – Product Requirements.

B. Furnish materials in accordance with Division 600 of SCDOT Standard Specifications.

C. Waterborne Paint: Ready mixed, fast dry waterborne traffic paints, lead-free, non-toxic, suitable for roadway or parking lots.

D. Thermoplastic: Alkyd based ready mixed, fast dry, lead free, non toxic, for roadways.

E. Glass Beads: AASHTO M247, Type 1, coated to enhance embedment and adherence with paint.

2.2 EQUIPMENT

A. Roadway Application for Continuous Longitudinal Lines: Use equipment with following capabilities.
1. Dual nozzle paint gun to simultaneously apply parallel lines of indicated width in solid or broken patterns or various combinations of those patterns.
2. Pressurized bead-gun to automatically dispense glass beads onto painted surface, at required application rate.
3. Measuring device to automatically and continuously measure length of each line placed, to nearest foot.
4. Device to heat paint to manufacturer's temperature recommendation for fast dry and thermoplastic applications.

B. Machine Calibration: Calibrate machines to meet specified tolerances.

C. Other Equipment: For application of crosswalks, intersections, stop lines, legends and other miscellaneous items by walk behind stripers, hand spray or stencil trucks, apply with equipment meeting requirements of this section. Do not use hand brushes or rollers. Optionally apply glass beads by hand.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Do not apply paint to concrete surfaces until concrete has cured for 28 days.

3.2 PREPARATION

A. Maintenance and Protection of Traffic:
1. Provide short term traffic control in accordance with Section 01 50 00 - Temporary Facilities and Controls.

2. Prevent traffic from interrupting or driving on newly applied markings before markings dry.
3. Maintain roadway travel lanes between 7:00 a.m. to 9:00 a.m. and between 4:00 p.m. and 6:00 p.m.
4. Maintain access to existing businesses and other properties requiring access.

B. Surface Preparation.
1. Clean and dry paved surface prior to painting.
2. Blow or sweep surface free of dirt, debris, oil, grease, or gasoline.
3. Spot location of final pavement markings as specified and as indicated on Drawings by applying pavement spots 25 feet on center.
4. Notify Engineer after placing pavement spots and minimum three days prior to applying traffic lines.

3.3 EXISTING WORK

A. Remove existing markings in an acceptable manner. Do not remove existing pavement markings by painting over with black paint. Remove by methods that will cause least damage to pavement structure or pavement surface. Satisfactorily repair any pavement or surface damage caused by removal methods.

B. Clean and repair existing or remaining lines and legends.

3.4 APPLICATION

A. Agitate paint for 1-15 minutes prior to application to ensure even distribution of paint pigment.

B. Dispense paint at temperature recommended by manufacturer to wet-film thickness of 15 mils.

C. Dispense thermoplastic at temperature recommended by manufacture to thickness of:
1. 120 mils for center lines, skip lines, transverse markings, and legends.
2. 90 mils for edge lines diagonals and arrow symbols.

D. Apply glass beads at rate of 1 to 3 pounds per gallon of paint.

E. Apply markings to indicated dimensions at indicated locations.

F. Prevent splattering and over spray when applying markings.

G. Unless material is track free at end of paint application convoy, use traffic cones to protect markings from traffic until track free.

H. When vehicle crosses a marking and tracks it or when splattering or overspray occurs, eradicate affected marking and resultant tracking and apply new markings.

I. Collect and legally dispose of residues from painting operations.

3.5 APPLICATION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Variation from Wet Film Thickness: 1 mil.

C. Maximum Variation from Wet Paint Line Width: Plus or minus 1/8 inch.

D. Maintain cycle length for skip lines at tolerance of plus or minus 6 inches per 40 feet and line length or plus or minus 3 inches per 10 feet.

E. Maximum Variation from Specified Application Temperature: Plus or minus 5 degrees F.

3.6 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect for incorrect location, insufficient thickness, line width, coverage, retention, uncured or discolored material, and insufficient bonding.

C. Repair lines and markings which after application and curing do not meet following criteria:
1. Incorrect Location: Remove and replace incorrectly placed patterns.
2. Insufficient Thickness, Line Width, Paint Coverage, Retention or Glass Bead Coverage (where required): Prepare defective material by acceptably grinding or blast cleaning to remove substantial amount of beads and to roughen marking surface. Remove loose particles and debris. Apply new markings on cleaned surface in accordance with this Section.
3. Uncured or Discolored Material, Insufficient Bonding: Remove defective markings in accordance with this Section and clean pavement surface one foot beyond affected area. Apply new markings on cleaned surface in accordance with this Section.

D. Replace failed or defective markings in entire section of defective markings within 30 days after notification when any of the following exists:
1. Marking is discolored or exhibits pigment loss and is determined to be unacceptable by visual comparison with beaded color plates.
2. If glass beads are used, the average retro-reflectivity is less than 375 mcd/m2/1x for white pavement markings and 250 mcd/m2/1x for yellow pavement markings.

E. When eradication of existing paint lines is necessary, eradicate by shot blast or water blast method. Do not gouge or groove pavement more than 1/16 inch during removal. Limit area of removal to area of marking plus 1 inch on all sides. Prevent damage to transverse and longitudinal joint sealers, and repair any damage according to requirements in Section 32 12 16 or Section 32 13 13.

F. Maintain daily log showing work complete, results of inspections or tests, pavement and air temperatures, relative humidity, presence of any moisture on pavement, and any material or equipment problems. Make legible entries in log in ink, sign, and submit by

end of each work day. Enter environmental data into log prior to starting work each day and at two additional times during day.

3.7 PROTECTION OF FINISHED WORK

A. Protect painted pavement markings from vehicular and pedestrian traffic until paint is dry and track free. Follow manufacturer's recommendations or use minimum of 30 minutes. Consider barrier cones as satisfactory protection for materials requiring more than two minutes dry time.

3.8 SCHEDULES

A. Pavement Markings:

Items	Location
4 inch white paint	Parking lot lines
4 inch yellow paint	Parking lot lane lines
24 inch white thermoplastic	Stop line
4 inch yellow thermoplastic	Roadway center lines
4 inch white thermoplastic	Roadway edge lines

END OF SECTION

SECTION 323124 – ORNAMENTAL ALUMINUM FENCING AND GATES

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. Ornamental aluminum fencing panels fabricated from extruded aluminum sections with louvered aluminum panels, including aluminum fence posts and gates.

B. Related Sections:

1. Division 03 Section "Cast-in-Place Concrete" for concrete footings supporting fence posts.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM) Publications:
1. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
2. ASTM B221 - Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube.
3. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.
4. ASTM D822 - Tests on Paint and Related Coatings Using Filtered Open-Flame Carbon-Arc Exposure Apparatus.
5. ASTM D2794 - Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
6. ASTM D3363 - Test Method for Film Hardness by Pencil Test.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product components and accessories.
B. Shop drawings showing layout, dimensions, spacing of components, anchorage and installation details.
C. Sample: 8 x 10 inches (203 x 254 mm) minimum size sample of fence panel illustrating design, fabrication workmanship, and selected color coating.
D. Sustainable Design Submittals:
1. Product Data: For installation adhesives, indicating VOC content.

2. Laboratory Test Reports: For installation adhesives, indicating compliance with requirements for low-emitting materials, requirements for low-emitting materials
3. One or more of the following:
   a. Environmental Product Declaration: For each product.
   b. Third-Party Certifications: For each product.
   c. Third-Party Certified Life Cycle Assessment: For each product.

4. Environmental Product Declaration: For each product.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.
B. Warranty: Sample of manufacturer's warranty.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
B. Source Limitations: Obtain primary fencing system and materials through one source from a single manufacturer.

1.7 WARRANTY

A. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail within specified warranty period. Warranty does not include normal weathering.

1. Failure includes cracking, peeling, or blistering under normal use.
2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Extruded aluminum: ASTM B221, Alloy 6063, Temper T-6.
B. Sheet aluminum: ASTM B209 6063, Temper T-6.
C. Grout: Non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, and water reducing and plasticizing additives.

2.2 ORNAMENTAL ALUMINUM FENCE SYSTEM

A. Basis-of-Design Product: Subject to compliance with requirements, provide ornamental fence system as manufactured by Ametco Manufacturing Corporation; or comparable products by other manufacturers submitted for acceptance within the bidding period.

B. Fence Panels:
   1. Type: Ornamental fencing system consisting of fixed louver modular fence panels fabricated with formed aluminum louvers and flat aluminum bars welded to back of louvers and supported by aluminum fence posts and aluminum louver gates and gate hardware.
      a. Basis of Design: Eclipse Aluminum Fixed Louver Fencing by Ametco Manufacturing Corporation.
   2. Fixed louver fence panel:
      a. Horizontal fixed louver bars: Formed aluminum louver bars, 1-31/32 inches wide, spaced at 2-1/16 inches. Extend louver flange to allow 80 percent direct visual screening.
      b. Cross bars: 1/2 by 1/8 inch flat bars welded perpendicular to back side of louver bars and spaced at 18 inches.
   3. Panel height: As noted on Drawings
   4. Panel width: As noted on Drawings

C. Posts: 3 x 3 inch extruded aluminum tubular shapes. Weld flat aluminum bar top caps to gate posts. Larger posts as required by gate size and/or fence size. All adjacent post sizes shall be the same size.

D. Gates: Provide gates of type and size indicated on Drawings. Equip gates with manufacturer's standard hardware as required for complete functional operation.

   1. Single Leaf Pedestrian Type: Side hinged swinging single gate where indicated on Drawings.
   2. Double Leaf Type: Side hinged swinging (paired) double gates where indicated on Drawings.
   3. Construction: Welded frame fabricated from 2 x 2 inches extruded aluminum tubing on perimeter with aluminum louver panels to match fencing material.
   4. Hinges: Size and type as determined by manufacturer. Provide 2 hinges for each leaf up to 6 feet high and 1 additional hinge for each additional 24 inches in height or fraction thereof.
   5. Single leaf gate latch: 3/4 inch (19 mm) diameter slide bolt to accommodate padlock.
   6. Double leaf gate latch: 3/4 inch (19 mm) diameter slide bolt to accommodate padlock and 5/8 inch (16 mm) diameter center cane bolt assembly and strike to accommodate padlock.

E. Accessories
   1. Stainless steel bolts of type and size as recommended by manufacturer for securing fence panels to intermediate and end posts.
   2. End caps: Provide aluminum caps for exposed open extruded aluminum sections and for attachments of components to posts.

2.3 FINISHES

A. Aluminum fence panels and posts shall receive polyester powder coating.

B. Polyester powder coating: Electrostatically applied colored polyester powder coating heat cured to chemically bond finish to metal substrate.

1. Minimum hardness measured in accordance with ASTM D3363: 2H.
2. Direct impact resistance tested in accordance with ASTM D2794: Withstand 160 inch-pounds.
3. Salt spray resistance tested in accordance with ASTM B117: No undercutting, rusting, or blistering after 500 hours in 5 percent salt spray at 95 degrees F and 95 percent relative humidity and after 1000 hours less than 3/16 inch (5 mm) undercutting.
4. Weatherability tested in accordance with ASTM D822: No film failure and 88 percent gloss retention after 1 year exposure in South Florida with test panels tilted at 45 degrees.

C. Color: To match Architect's sample. (including metallic finishes).

PART 3 - EXECUTION

3.1 PREPARATION

A. Field verify required dimensions prior to fabrication.

3.2 INSTALLATION

A. Install fencing in accordance with manufacturer's installation instructions and approved shop drawings.

B. Cast concrete footings in accordance with Section 033000 "Cast-in-Place Concrete" and as detailed on Drawings and approved shop drawings.

1. Minimum footing diameter for terminal and gate posts: 12 inches (305 mm). Coordinate post footings with concrete footing for adjacent masonry wall construction.
2. Minimum concrete depth beneath post bottom: 6 inches (152 mm).

C. Install gate posts plumb and level by embedding posts 30 inches deep directly in concrete footing. Temporarily brace gate posts with 2 by 4 wood supports until concrete is set.

D. Provide concrete center foundation depth and drop rod retainers at center of double leaf gate openings.

E. Do not install bent, bowed, or otherwise damaged panels. Remove damaged components from site and replace.

F. Secure fence panels with standard stainless steel bolts to intermediate fence posts after posts have been set in footings.

G. Install gates and adjust hardware for smooth operation.
H. Provide concrete center foundation depth and drop rod retainers at center of double swinging gate openings.
I. After installation, test gate hardware and operation. Open and close a minimum of five times. Correct deficiencies and make adjustments for unimpeded operation.
J. Touch-up damaged finish with paint supplied by manufacturer and matching original coating.

END OF SECTION 323120

SECTION 328400 – IRRIGATION

PART 1 - GENERAL

1.1 SECTION INCLUDES, BUT NOT LIMITED TO: Provide complete commercial grade irrigation system for the site and building planters, designed, installed, tested and approved, including but not necessarily limited to:

A. Standard, head to head, matched precipitation, full coverage sprinkler system.

B. Automatic controllers and remote control valves.

C. Wells, pumps, water meters, backflow prevention and controls for each respectively.

D. Connection to approved electrical source.

E. Subsurface drip irrigation is to be buried 3" to 4" below surface and installed in a grid pattern within planted areas.

1.2 RELATED WORK

A. 329200 : Turfs and Grasses

B. 329300 : Plants

1.3 QUALITY ASSURANCE

A. Work shall be performed by a single firm specializing and experienced (minimum 5 years) in irrigation design and installation.

B. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

C. System shall comply with the requirements of authority (ies) have jurisdiction. Contractor shall be responsible for obtaining, paying for, and documenting to the Architect, all required approvals.

1.4. SUBMITTALS

A. Product Data: Upon acceptance by Architect of system design, submit the following:

1. Materials list of items proposed to be provided under this section.

2. Manufacturer's specifications and other data needed to prove compliance with the

specified requirements.

3. Manufacturer's recommended installation procedures which, when accepted by the Owner, will become the basis for accepting or rejecting actual installation procedures used on the work.

B. Submit typewritten operations and maintenance instructions for completed system.

C. Upon completion of the work, furnish the Architect three (3) copies of Inspection Certificate from authority (ies) having jurisdiction, as required.

D. Submit complete Record Drawings for all aspects of the system.

1.5 WARRANTY: Warranty complete irrigation system for one full year from the date of Final Acceptance.

PART 2 - PRODUCTS

2.1 PIPE

A. Galvanized steel pipe:

1. Comply with ASTM A120 or ASTM A53, galvanized schedule 40, threaded, coupled and hot-dipped galvanized.

2. Fittings; use 150 lb. rated galvanized malleable iron.

3. Steel sleeving to be schedule 40 black steel or ductile iron under areas of street traffic.

B. Plastic Pipe:

1. Use Poly Chloride (PVC) of following ratings: SDR 26, Class 160, 1120 and 1220- SDR 21, Class 200, 1120 and 1220 - schedule 40, all clearly marked by manufacturer the entire length of pipe.

2. Fittings: Use Schedule-40 PVC bearing the seal of the manufacturer and complying with ASTM D2466.

3. For solvent weld type pipe use a cleaner, primer, and cement complying with ASTM D2466 and pressure tested for leaks prior to final approval.

4. Plastic pipe identification: manufacturer's name pipe, size, and material type material shall be permanently marked full length of pipe.

2.2 VALVES

A. Gate Valves:

1. Valves should provide 200 PSI rating, with female IPS threads, and sized to the attached pipe size.

2. Acceptable manufacturers Hammond, Matco, Conbraco, or approved equal.

B. Quick couple valves:

1. Brass, one-piece construction, with hinged debris cover and double lug insert connection.

2. Provide Owner with quick couple keys and hose adapters as needed.

2.3 SPRINKLER HEADS

A. Provide the specified sprinkler heads per approved design.

B. Any substitutions of sprinklers or change in the design of the system must be submitted ten (10) days prior to acceptance of the bid.

C. Sprinklers must meet manufacturers specifications for spacing and matched precipitation rates.

2.4 DRIP EMITTER HEADS

A. Sub surface drip irrigation as manufactured by Netafim Corp. and as designed with one pressure compensation emitter on 12" centers and each emitter to discharge .9 gallons per hour.

2.5 BACKFLOW PREVENTION

A. Backflow device shall be approved by state and local authority(ies) having jurisdiction, and installed per their requirements, as well as per manufacturer's recommendations.

B. Contractor shall be responsible for determining the required device(s) and for providing a fully compliant, approved installation.

2.6 AUTOMATIC IRRIGATION CONTROLLER

A. Provide controller(s) per approved design and in compliance with the manufacturer's requirements.

B. Controller(s) shall be supplied with 110/120 volt AC current and shall have transformer to

convert to 24/26 volt AC output.

C. Controllers installed in exterior conditions shall be in weather resistant boxes and shall have internal transformers.

D. Substitution of specified control system must be submitted ten (10) days prior to acceptance of bid.

E. If specified remote control valves may be of battery power type and programmed independent of each other as manufactured by DIG.

2.7 ELECTRIC CONTROL VALVES

A. Provide valves per approved design and in compliance with the manufacturer's requirements.

B. Valves to be solenoid type and rated for 24/26 volts as current (unless design specifies battery operated valves). Valves should be sized to have a maximum of 5-PSI loss through the valve, and not necessarily sized to the size of the pipe.

C. Substitution of valves other than specified must be submitted ten (10) days prior to acceptance of bid.

2.8 BATTERY POWERED CONTROL VALVES (for drip emitter heads)

A. Provide valves per approved design and in compliance with the manufacturer's requirements.

B. Battery Powered Control Valves: battery powered, programmable, as manufactured by DIG Corporation, or approved equal.

2.9 VALVE BOXES

A. All electric valves shall be installed in approved boxes marked irrigation, and sized to provide easy access to solenoid and flow control device.

B. Boxes to be installed at finish grade and have a snap or other method of securing lid.

C. Acceptable manufacturers include: Ametek, Carson-Brooks, NDS, or approved equal.

2.10 OTHER MATERIALS

A. Electrical material shall include:

1. Connection from controller shall be solid strand copper wire with UF, UL, 600 volt rating.

2. Splices shall be made with 3M DBY or other approved splicers.

3. Earth grounding shall be made with 5/8" copper clad rod and connected to earth ground contact of controller.

B. Provide other materials not specifically described, that are required for a complete, proper and approved installation, as selected by the Contractor, and subject to the approval of the Architect.

PART 3 - EXECUTION

3.1 SITE CONDITIONS

A. Prior to installation, the site shall be inspected to determine that it is ready for installation of irrigation system.

B. Any necessary corrections to site shall be performed prior to starting work. Do not start project until unsatisfactory conditions are corrected.

C. Determine location of underground utilities and perform work in a manner, which shall avoid damage. Utilities not necessarily shown on drawings. Hand excavate adjacent to utility lines. If conflicts between utilities and irrigation system are encountered, notify Architect for direction before installation.

3.2 FIELD MEASUREMENTS

A. Follow approved design accurately when field staking system.

B. Actual locations of heads, valves and pipes may vary slightly due to site conditions.

C. Obtain approval by Owner of stakeout prior to beginning installation.

3.3 TRENCHING AND BACKFILLING

A. Trenches shall be to depth noted on the approved design, and shall be free of any debris, roots, or other obstructions. Bottoms of trenches shall be level.

B. Trenches shall be backfilled at the end of each working day.

C. Backfilling of trenches should be in accordance with earthwork specifications.

3.4 INSTALLATION OF PIPING

A. Install piping in accordance with the approved design. Field adjustments shall be made only when absolutely necessary to accommodate the site. Sizing of pipe should remain as designed to insure proper flow and pressure loss.

B. Carefully inspect pipe and fittings before installation to remove all dirt, burrs, and damaged material.

C. Install PVC pipe so that manufacturer's marking can be inspected.

D. Make all joints in plastic pipe using solvents as specified.

E. Snake pipe in bottom of trench from side to side to allow for expansion and contraction.

F. For metal to plastic connections, use female PVC fittings and use a non-petroleum based pipe dope. (Teflon dope or approved equal.)

3.5 INSTALLATION OF EQUIPMENT

A. Install control valves in accordance with manufacturer recommendations, and as provided by the approved design. Excavation below each valve shall be 12" below bottom of valve, back-filled with gravel to bottom of valve location prior to installing valve.

B. Install quick couplers flush with finish grade and minimum of 12" from paved areas and other irrigation components. Excavation below each valve shall be 12" below bottom of valve, backfilled with gravel to bottom of valve location prior to installing valve.

C. Install sprinkler heads in accordance with manufacturer recommendations and as provided by the approved design.

D. Install drip emitters in accordance with manufacturer recommendations and as provided by the approved tubing to be staked at intervals of 3' in trench to insure proper depth before backfilling.

E. Water source connection(s) and Backflow preventer shall be installed, inspected and approved as required by state and local authority(ies) having jurisdiction.

F. Control wiring shall be installed in the trench with piping and to the side of pipe, not beneath pipe. Provide adequate slack in wire to prevent stretching or stress to connections. Splice with approved 3M DBY splice kits or approved equal.

G. Keep pavements clean and work areas in orderly condition. Periodically (minimum once per week) remove from site all debris and excess material.

3.6 TESTING AND INSPECTION

A. Allow for the inspection of piping, wiring, and connections, by the authority(ies) having jurisdiction, and by the Owner, prior to covering trenches.

B. All main lines and laterals shall be completely flushed prior to the installation of sprinklers.

C. Provide personnel and necessary equipment for inspection and testing of system. Assure complete and satisfactory operation of the system.

D. Final Acceptance: Final inspection shall consist of operational walk through with Owner to insure system is adjusted properly and is installed and working in accordance with the ap-

proved design. Contractor shall assure that the Owner understands the operation and maintenance of the complete system.

3.7 RECORD DRAWINGS

A. Following approval of the system, Contractor shall submit a complete Record Drawing of the entire system. Record Drawing shall be prepared by field survey, which shall be certified by a licensed land surveyor. All costs associated with the preparation and certification of the Record Drawings shall be borne entirely by the Contractor.

END OF SECTION – 328400

SECTION 329200 - TURF AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Seeding.
2. Sodding.

1.2 DEFINITIONS

A. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.

B. Finish Grade: Elevation of finished surface of planting soil.

C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

D. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

E. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

F. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

G. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.

H. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

I. Surface Soil: Whatever soil is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.3 SUBMITTALS

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

B. Certification of grass seed.

1. Certification of each seed mixture for turfgrass sod.

C. Product certificates.

1.4 QUALITY ASSURANCE

A. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

1. Pesticide Applicator: State licensed, commercial.

B. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory.

1. The soil-testing laboratory shall oversee soil sampling.
2. Report suitability of tested soil for turf growth.

a. State recommendations for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
b. Report presence of problem salts, minerals, or heavy metals; if present, provide additional recommendations for corrective action.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.

B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.

1.6 MAINTENANCE SERVICE

A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable turf is established but for not less than the following periods:

1. Sodded Turf: 30 days from date of planting completion.

PART 2 - PRODUCTS

2.1 TURFGRASS SOD

A. Turfgrass Sod: Certified and Approved sod including limitations on thatch, weeds, diseases, nematodes, and insects], complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.

B. Turfgrass Species: Sod of grass species as follows:

1. Centipede

C. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as needed.

D. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, and with a minimum of 99 percent passing through.

E. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

F. Aluminum Sulfate: Commercial grade, unadulterated.

G. Perlite: Horticultural perlite, soil amendment grade.

H. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through.

I. Sand: Clean, washed, natural or manufactured, and free of toxic materials.

J. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.

K. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.2 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1 inch sieve; soluble salt content of 8 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings.

B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture, with a pH range of 3.4 to 4.8.

C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent.

D. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.

E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

2.3 FERTILIZERS

A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and 20 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.

D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.

2.4 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

B. Sphagnum Peat Mulch: Partially decomposed sphagnum peat moss, finely divided or of granular texture, and with a pH range of 3.4 to 4.8.

C. Muck Peat Mulch: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent.

D. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1 inch sieve; soluble salt content of 3 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings.

2.5 PESTICIDES

A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

PART 3 - EXECUTION

3.1 TURF AREA PREPARATION

A. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 6 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply fertilizer directly to subgrade before loosening.
2. Thoroughly blend planting soil off-site before spreading or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
3. Spread planting soil to a depth of 6 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

    a. Reduce elevation of planting soil to allow for soil thickness of sod.

B. Unchanged Subgrades: If turf is to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:

1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
2. Loosen surface soil to a depth of at least 6 inches. Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 6 inches of soil. Till soil to a homogeneous mixture of fine texture.

    a. Apply fertilizer directly to surface soil before loosening.

3. Remove stones larger than 1 inch in any dimension and sticks, roots, trash, and other extraneous matter.
4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.

C. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus .5 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.

D. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

E. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.2 SODDING

A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.

B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across angle of slopes exceeding 1:3.
2. Anchor sod on slopes exceeding 1:6 with steel staples spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.

C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1.5 inches below sod.

3.3 TURF MAINTENANCE

A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

B. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain height appropriate for species without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings.

C. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

3.4 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Architect:
1. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.

B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

END OF SECTION 329200

SECTION 32 91 19
LANDSCAPE GRADING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Final grade topsoil for finish landscaping.
2. Testing Topsoil.
3. Supplying Topsoil.
4. Scarifying substrate surface.
5. Placing and lightly compacting topsoil.
6. Removing excess topsoil from site.

B. Related Sections:
1.
2. Section 31 23 16 - Excavation and Fill: Cutting and filling to site subgrade.
3. Section 31 23 17 - Trenching: Backfilling trenches to subgrade.
4. Section 32 92 19 - Seeding.
5. Section 32 92 23 - Sodding.
6. Section 32 93 00 - Plants: Topsoil fill for trees, plants and ground cover.

1.2 REFERENCES

A. SCDOT Standard Specifications:
1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Test Results: Submit results of topsoil tests to determine soil amendments required.

C. Samples: Submit to testing laboratory for independent test, in air-tight containers, 10 pound sample of topsoil.

D. Materials Source: Submit name and location of imported materials source.

1.4 QUALITY ASSURANCE

A. Furnish each topsoil material from single source throughout the Work.

B. Perform Work in accordance with applicable portions of Division 800 of SCDOT Standard Specifications.

C. Maintain one copy on site.

PART 2 PRODUCTS

2.1 MATERIAL

A. Topsoil: Original surface soil typical of the area, which is capable of supporting native plant growth; free of large stones, roots, waste, debris, contamination, or other unsuitable material, which may be detrimental to plant growth; pH value of 5.4 to 7.0.

B. Suitable material excavated from site, amended per requirements of tests is acceptable.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify building and trench backfilling have been inspected.

C. Verify substrate base has been contoured and compacted.

3.2 PREPARATION

A. Protect landscaping and other features remaining as final Work.

B. Protect existing structures, fences, sidewalks, utilities, paving, and curbs.

3.3 SUBSTRATE PREPARATION

A. Eliminate uneven areas and low spots.

B. Remove debris, roots, branches, stones, in excess of 1 inch in size. Remove contaminated subsoil.

C. Scarify surface to depth of 6 inches where topsoil is scheduled. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

3.4 PLACING TOPSOIL

A. Place topsoil in areas where seeding, sodding, and planting is required to thickness as scheduled. Place topsoil during dry weather.

B. Fine grade topsoil to eliminate rough or low areas. Maintain profiles and contour of subgrade.

C. Remove roots, weeds, rocks, and foreign material while spreading.

D. Manually spread topsoil close to plant material, buildings, and pavement to prevent damage.

E. Lightly compact placed topsoil.

F. Remove surplus subsoil and topsoil from site.

G. Leave stockpile area and site clean and raked, ready to receive landscaping.

3.5 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Top of Topsoil: Plus or minus 1/2 inch.

3.6 PROTECTION OF INSTALLED WORK

A. Prohibit construction traffic over topsoil. Scarify and regrade disturbed areas.

3.7 SCHEDULES

A. Compacted topsoil thicknesses:
1. Seeded Areas: 6 inches.
2. Sodded Areas: 4 inches.
3. Shrub Beds: 18 inches.
4. Flower Beds: 12 inches.
5. Planter Boxes: To within 3 inches of box rim.
6. Trees: As indicated on Drawings.

END OF SECTION

SECTION 32 92 19
SEEDING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Fertilizing.
2. Seeding.
3. Hydroseeding.
4. Mulching.
5. Maintenance.

B. Related Sections:
1. Section 32 84 00 - Planting Irrigation: Irrigation system for seeded areas.
2. Section 32 91 19 - Landscape Grading: Preparation and placement of topsoil in preparation for the Work of this Section.
3. Section 32 92 23 - Sodding.
4. Section 32 93 00 - Plants.

1.2 REFERENCES

A. ASTM International:
1. ASTM C602 - Standard Specification for Agricultural Liming Materials.

B. SCDOT Standard Specifications:
1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.

1.3 DEFINITIONS

A. Weeds: Vegetative species other than specified species to be established in given area.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data for seed mix, fertilizer, mulch, and other accessories.

C. Test Reports: Indicate topsoil nutrient and pH levels with recommended soil supplements and application rates.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

E. Invoices or proof of purchase to verify quantities specified.

F. Operation and Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; and, types, application frequency, and recommended coverage of fertilizer.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with Section 810 of SCDOT Standard Specifications.
B. Maintain copy of document on site.

1.6 QUALIFICATIONS

A. Seed Supplier: Company specializing in manufacturing products specified in this Section with minimum 3 years documented experience.

B. Installer: Company specializing in performing work of this Section with minimum 5 years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Deliver grass seed mixture in sealed containers showing percentage of seed mix, germination, inert matter and weeds; year of production; net weight; date of packaging; and location of packaging. Seed in damaged packaging is not acceptable.

C. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.8 MAINTENANCE SERVICE

A. Maintain seeded areas immediately after placement until grass is well established and exhibits vigorous growing condition for minimum of three cuttings.

PART 2 PRODUCTS

2.1 TOPSOIL MATERIALS

A. Conform to Section 32 91 19. Topsoil: Original surface soil typical of the area, which is capable of supporting native plant growth; free of large stones, roots, waste, debris, contamination, or other unsuitable material, which may be detrimental to plant growth; pH value of 5.4 to 7.0.

2.2 SEED MIXTURE

A. Furnish materials in accordance with South Carolina Board of Agriculture rules and regulations as specified in Section 810 of SCDOT Standard Specifications.

1. Piedmont Region:

Tall fescue	80 lbs/acre
Sericea lespedeza	20 lbs/acre
Kobe lespedeza	10 lbs/acre

2.3 ACCESSORIES

A. Mulching Material: Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.

B. Fertilizer: Commercial grade; recommended for grass; of proportion necessary to eliminate deficiencies of topsoil, as indicated in analysis. When test is not available, use 10-10-10 mixture of Nitrogen, phosphoric acid, and soluble potash.

C. Lime: ASTM C602, Class T or Class O agricultural limestone containing a minimum 80 percent calcium carbonate equivalent.

D. Water: Clean, fresh and free of substances or matter capable of inhibiting vigorous growth of grass.

E. Erosion Fabric: Jute matting, open weave.

F. Herbicide: As required to combat type of weeds encountered.

G. Stakes: Softwood lumber, chisel pointed.

H. String: Inorganic fiber.

PART 3 EXECUTION

3.1 EXAMINATION

A. Administrative Requirements: Verification of existing conditions before starting Work.

B. Verify prepared soil base and topsoil are ready to receive the Work of this Section.

3.2 FERTILIZING

A. Apply lime at application rate recommended by soil analysis. Work lime into top 6 inches of soil.

B. Apply fertilizer at application rate recommended by soil analysis.

C. Apply after smooth raking of topsoil and prior to roller compaction.

D. Do not apply fertilizer at same time or with same machine used to apply seed.

E. Mix fertilizer thoroughly into upper 2 inches of topsoil.

F. Lightly water soil to aid dissipation of fertilizer. Irrigate top level of soil uniformly.

3.3 SEEDING

A. Apply seed evenly in two intersecting directions at the rates shown above. Rake in lightly.

B. Do not seed areas in excess of that which can be mulched on same day.

C. Planting Season:
1. Piedmont Region:
a. Fall: August 15 – September 15.
b. Late Winter: February 15 – March 21.

D. Do not sow immediately following rain, when ground is too dry, or when winds are over 12 mph.

E. Roll seeded area with roller not exceeding 112 lbs/linear foot.

F. Immediately following seeding and rolling, apply mulch to thickness of 1/8 inch. Maintain clear of shrubs and trees.

G. Apply water with fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

3.4 HYDROSEEDING

A. Apply fertilizer, mulch and seeded slurry with hydraulic seeder at rate of 6 lbs per 1,000 square feet evenly in one pass.

B. Apply water with fine spray immediately after each area has been hydroseeded. Saturate to 4 inches of soil and maintain moisture levels two to four inches.

3.5 SEED PROTECTION

A. Identify seeded areas with stakes and string around area periphery. Set string height to 12 inches. Space stakes at 5 feet on center.

B. Cover seeded slopes where grade is greater than 3 H:1 V with erosion fabric. Roll fabric onto slopes without stretching or pulling.

C. Lay fabric smoothly on surface, bury top end of each section in 6 inch deep excavated topsoil trench. Overlap edges and ends of adjacent rolls minimum 12 inches. Backfill trench and rake smooth, level with adjacent soil.

D. Secure outside edges and overlaps at 36 inch intervals with stakes.

E. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.

F. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches.

3.6 MAINTENANCE

A. Mow grass at regular intervals to maintain at maximum height of 2-1/2 inches. Do not cut more than 1/3 of grass blade at each mowing. Perform first mowing when seedlings are 40 percent higher than desired height.

B. Neatly trim edges and hand clip where necessary.

C. Immediately remove clippings after mowing and trimming. Do not let clippings lay in clumps.

D. Water to prevent grass and soil from drying out.

E. Roll surface to remove minor depressions or irregularities.

F. Control growth of weeds. Apply herbicides. Remedy damage resulting from improper use of herbicides.

G. Immediately reseed areas showing bare spots.

H. Repair washouts or gullies.

I. Protect seeded areas with warning signs during maintenance period.

3.7 SCHEDULE

A. Lawn Area: Mix Type 1, 4-inch top soil.

B. Pond Slopes: Mix type 2, 4-inch top soil.

END OF SECTION

SECTION 32 92 23
SODDING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fertilizing.
   2. Sod installation.
   3. Maintenance.

B. Related Sections:
   1. Section 32 92 19 - Seeding.
   2. Section 32 93 00 - Plants.

1.2 REFERENCES

A. ASTM International:
   1. ASTM C602 - Standard Specification for Agricultural Liming Materials.

B. SCDOT Standard Specifications:
   1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.

C. Turfgrass Producers International:
   1. TPI - Guideline Specifications to Turfgrass Sodding.

1.3 DEFINITIONS

A. Weeds: Vegetative species other than specified species to be established in given area.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data for sod grass species, fertilizer, mulch, and other accessories.

C. Test Reports: Indicate topsoil nutrient and pH levels with recommended soil supplements and application rates.

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

E. Invoices or proof of purchase to verify quantities specified.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer.

1.6 QUALITY ASSURANCE

A. Sod: Root development capable of supporting its own weight without tearing, when suspended vertically by holding upper two corners.

B. Perform Work in accordance with Section 813 of SCDOT Standard Specifications.

C. Maintain one copy of document on site.

1.7 QUALIFICATIONS

A. Sod Producer: Company specializing in manufacturing Products specified in this Section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Deliver sod on pallets. Protect exposed roots from dehydration.

C. Do not deliver more sod than can be laid within 24 hours.

1.9 MAINTENANCE SERVICE

A. Maintain sodded areas immediately after placement until grass is well established and exhibits vigorous growing condition for three cuttings.

PART 2 PRODUCTS

2.1 GENERAL

A. Furnish materials in accordance with South Carolina Board of Agriculture rules and regulations as specified in Section 813 of SCDOT Standard Specifications.

2.2 TOPSOIL MATERIALS

A. Conform to Section 32 91 19. Topsoil: Original surface soil typical of the area, which is capable of supporting native plant growth; free of large stones, roots, waste, debris, contamination, or other unsuitable material, which may be detrimental to plant growth; pH value of 5.4 to 7.0.

2.3 SOD

A. Sod: TPI defined Field grown; cultivated grass sod; type indicated below; with strong fibrous root system, free of stones, burned or bare spots; containing no more than

five weeds per 1,000 square feet.

Cool Season Grasses	Varieties	Region
Kentucky Bluegrass Blend		Mountain
Tall Fescue Blend	Adventure, Brookston, Falcon, Finelawn, Galway, Houndog, Jaguar, Olympic, Rebel	Mountain and Piedmont
Tall Fescue/Kentucky Bluegrass Blend		Mountain and Piedmont
Warm Season Grasses	**Varieties**	**Region**
Hybrid Bermuda Grass	Vamont, Tifway, Tifway II, Tifgreen	Piedmont and Coastal Plain
Zoysia Grass	Emerald, Meyer	Piedmont and Coastal Plain
Centipede Grass		Piedmont and Coastal Plain
St. Augustine Grass	Raleigh	Piedmont and Coastal Plain

2.4 ACCESSORIES

A. Fertilizer: Commercial grade; recommended for grass; of proportion necessary to eliminate deficiencies of topsoil, as indicated in analysis. When test is not available, use 10-10-10 mixture of Nitrogen, phosphoric acid, and soluble potash.

B. Lime: ASTM C602, Class T or Class O agricultural limestone containing a minimum 80 percent calcium carbonate equivalent.

C. Water: Clean, fresh, and free of substances or matter capable of inhibiting vigorous growth of grass.

D. Herbicide: As required to combat type of weeds encountered.

E. String: Inorganic fiber.

F. Wood Pegs: Softwood, sufficient size and length to anchor sod on slope.

G. Surface Mesh: Interwoven hexagonal plastic mesh of 2 inch size.

2.5 HARVESTING SOD

A. Machine cut sod and load on pallets in accordance with TPI guidelines.

B. Cut sod in area not exceeding 1 sq yd, with minimum 1/2 inch and maximum 1 inch topsoil base.

PART 3 EXECUTION

3.1 EXAMINATION

A. Administrative Requirements: Verification of existing conditions before starting work.

B. Verify prepared soil base and topsoil are ready to receive the Work of this Section.

3.2 FERTILIZING

A. Apply lime at the application rate recommended by topsoil analysis or 2 tons per acre (100 pounds per 1000 square feet). Work lime into top 6 inches of soil.

B. Apply fertilizer at application rate recommended by soil analysis or 1,000 lbs per acre (25 pounds per 1,000 square feet) of 10-10-10 fertilizer in fall or 5-10-10 fertilizer in spring.

C. Apply after smooth raking of topsoil and prior to roller compaction.

D. Do not apply fertilizer at same time sod is applied.

E. Mix fertilizer thoroughly into upper 2 inches of topsoil.

F. Lightly water soil to aid dissipation of fertilizer. Irrigate top level of soil uniformly.

3.3 LAYING SOD

A. Moisten prepared surface immediately prior to laying sod.

B. Lay sod within 48 hours of being cut and within 24 hours after topsoil is prepared and fertilized.

C. Lay sod tight with no open joints visible, and no overlapping; stagger end joints 12 inches minimum. Do not stretch or overlap sod pieces.

D. Lay smooth. Align with adjoining grass areas.

E. Place top elevation of sod 1/2 inch below adjoining paving.

F. On slopes 6 inches per foot and steeper, lay sod perpendicular to slope and secure every row with wooden pegs at maximum 2 feet on center. When using "big roll", lay sod parallel to slope. Drive pegs flush with soil portion of sod.

G. Do not place sod when temperature is lower than 32 degrees F.

H. Prior to placing sod, on slopes exceeding 8 inches per foot or where indicated, place surface mesh over topsoil. Securely anchor mesh in place with wood pegs sunk firmly into ground.

I. Water sodded areas immediately after installation. Saturate soil to 4 inches.

J. After sod and soil have dried, roll sodded areas to bond sod to soil and to remove

minor depressions and irregularities. Roll sodded areas with roller not exceeding 112 pounds.

K. Roll before first watering.

3.4 MAINTENANCE

A. Mow grass at regular intervals to maintain at maximum height of 2-1/2 inches. Do not cut more than 1/3 of grass blade at each mowing. Perform first mowing when seedlings are 40 percent higher than desired height.

B. Neatly trim edges and hand clip where necessary.

C. Immediately remove clippings after mowing and trimming. Do not let clippings lay in clumps.

D. Water to prevent grass and soil from drying out.

E. Roll surface to remove minor depressions or irregularities.

F. Control growth of weeds. Apply herbicides. Remedy damage resulting from improper use of herbicides.

G. Immediately reseed areas showing bare spots.

H. Repair washouts or gullies.

I. Protect sodded areas with warning signs during maintenance period.

3.5 SCHEDULE

A. Lawn Area: Sod Type 1, 4-inch top soil.

B. Pond Slopes: Sod Type 2, 4-inch top soil.

END OF SECTION

SECTION 33 41 00
STORM UTILITY DRAINAGE PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Storm drainage piping.
2. Accessories.
3. Concrete Collars.

B. Related Sections:
1. Section 31 23 17 - Trenching: Excavation, bedding, and backfill requirements for trenching required by this Section.
2. Section 33 01 32 - Sewer and Manhole Testing: Pressure, infiltration, and deflection tests.
3. Section 33 05 14 - Utility Manholes and Structures: Concrete and masonry manholes, catch basins, inlets, junction boxes, and frames and grates for storm drains.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials
1. AASHTO M36 – Corrugated Steel Pipe, Metallic Coated, for Sewers and Drains.
2. AASHTO M190 – Bituminous-Coated Corrugated Metal Culvert Pipe and Pipe Arches.
3. AASHTO M196 – Corrugated Aluminum Pipe for Sewers and Drains.
4. AASHTO M294 – Corrugated Polyethylene Pipe

B. ASTM International:
1. ASTM C14 - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
2. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
3. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
4. ASTM C924 - Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method.
5. ASTM C969 - Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.
6. ASTM C1103 - Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.
7. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
8. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
9. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

C. SCDOT Standard Specifications:
1. Standard Specifications for Highway Construction, latest edition, published by

the South Carolina Department of Transportation.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data for pipe and pipe accessories.

C. Manufacturer's Installation Instructions: Submit special procedures required to install products specified.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents:
1. Accurately record actual locations of pipe runs, connections, catch basins, cleanouts, and invert elevations.
2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with SCDOT Standard Specifications.

B. Maintain one copy of document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum 5 years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum 5 years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Block individual and stockpiled pipe lengths to prevent moving.

C. Do not place pipe or pipe materials on private property or in areas obstructing pedestrian or vehicle traffic.

D. Do not place pipe flat on ground. Cradle to prevent point stress.

E. Store UV sensitive materials out of direct sunlight.

1.8 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate Work with local storm drain authority.

C. Notify affected utility companies minimum of 72 hours prior to construction.

PART 2 PRODUCTS

2.1 STORM DRAINAGE PIPING

A. Reinforced Concrete Pipe (RCP): ASTM C76, bell and spigot or tongue and groove ends.
1. Pipe Class: Class III with Wall Type B, or as otherwise specified on Drawings.
2. Fittings: Reinforced concrete.
3. Joints: ASTM C443, rubber compression gasket.

B. HDPE Corrugated Polyethylene Pipe: AASHTO M294, Type S or Type D.
1. Fittings: PVC conforming to pipe specifications.
2. Joints: ASTM F477, elastomeric gaskets.

C. Corrugated Metal Pipe (CMP):
1. Steel Pipe: ASSHTO M36.
2. Aluminum Pipe: AASHTO M196.
3. Fittings: Corrugated Steel or Aluminum to match pipe.
4. Joints: Corrugated coupling bands, galvanized steel or aluminum to match pipe, minimum 10 inches wide; connected with two neoprene "O" ring gaskets per and two galvanized steel bolts.

D. Bituminous Coated CMP: AASHTO M 190, Coated inside and out with 0.050 inch thick bituminous coating.

2.2 MANHOLES AND STRUCTURES

A. Manholes: As specified in Section 33 05 14 and indicated on Drawings; covers inscribed with "STORM SEWER."

B. Catch Basins, Inlets and Junction Boxes: Conform to Section 33 05 14 and as indicated on Drawings.

2.3 CONCRETE AND GROUT

A. Concrete: Class A Concrete conforming to Divisions 500 and 700 of the SCDOT Standard Specifications.
1. Compressive strength of 3,000 psi at 28 days.
2. Air entrained.
3. Water cement ratio of 0.488 with rounded aggregate and 0.532 with angular aggregate.
4. Maximum slump of 3.5 inch for vibrated concrete and 4 inch for non-vibrated concrete.
5. Minimum cement content of 564 pounds per cubic yard for vibrated concrete and 602 pounds per cubic yard for non-vibrated concrete.

B. Grout: Non-shrink, non-metallic in accordance with Divisions 500 and 700 of SCDOT Standard Specifications with a compressive strength of at least 5,000 psi at 3 days.

2.4 BEDDING AND COVER MATERIALS

A. General: Conform to Section 31 23 17 for bedding and backfill around and on top of pipe.

B. Bedding for Rigid Pipe (RCP): Clean sand, slightly silty sand, or slightly clayey sand having a Unified Soil Classification of SP, SP-SM or SP-SC.

C. Bedding for Flexible Pipe (HDPE and CMP): Clean course aggregate Gradation No. 57 conforming to Division 700 of the SCDOT Standard Specifications.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

A. Excavate pipe trench in accordance with Section 31 23 17.

B. Excavate to lines and grades shown on Drawings or required to accommodate installation of encasement.

C. Dewater excavations to maintain dry conditions and preserve final grades at bottom of excavation.

D. Provide sheeting and shoring in accordance with Section 31 23 17.

E. Place bedding material at trench bottom, level continuous layer not exceeding 8-inch compacted depth; compact to 95 percent per Section 31 23 17.

F. Maintain optimum moisture content of bedding material to attain required compaction density.

3.3 INSTALLATION – PIPE

A. Install in accordance with manufactures instructions and as indicated on Drawings.

B. Install plastic pipe, fittings, and accessories in accordance with ASTM D2321.

C. Seal joints watertight.

D. Lay pipe to slope gradients indicated on Drawings; with maximum variation from indicated slope of 1/8 inch in 10 feet. Begin at downstream end and progress upstream.

E. Assemble and handle pipe in accordance with manufacturer's instructions except as modified on the Drawings or by Engineer.

F. Keep pipe and fittings clean until work is completed and accepted by Engineer. Cap open ends during periods of work stoppage.

G. Lay bell and spigot pipe with bells upstream.

H. Connect pipe to existing sewer system as indicated on Drawings at existing manhole or using doghouse manhole connection per Section 33 05 14.

I. Install underground marking tape continuously 12 inches above pipe line.

J. Connect to subdrainage tile system piping. Refer to Section 33 46 00.

K. Install site storm drainage system piping to 5 feet of building and plug.

3.4 INSTALLATION - CONNECTION TO EXISTING STRUCTURES

A. Core drill existing manhole to clean opening. Do not use pneumatic hammers, chipping guns, and sledge hammers.

B. Install watertight neoprene gasket and seal with non-shrink concrete grout.

C. Concrete encase new sewer pipe minimum of 24 inches to nearest pipe joint. Use epoxy binder between new and existing concrete.

D. Prevent construction debris from entering existing sewer line when making connection.

3.5 INSTALLATION – MANHOLES, CATCH BASINS AND CLEANOUTS

A. Install manholes in accordance with Section 33 05 14.

B. Form bottom of excavation clean and smooth to correct elevation.

C. Form and place cast-in-place concrete base pad or pre-cast concrete base with provision for storm sewer pipe end sections.

D. Level top surface of base pad; sleeve concrete shaft sections to receive storm sewer pipe sections.

E. Establish elevations and pipe inverts for inlets and outlets as indicated on Drawings.

F. Mount lid and frame level in grout, secured to top cone section to elevation indicated.

3.6 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Request inspection prior to and immediately after placing bedding.

C. Perform tests on storm drain system in accordance with Section 33 01 34 and local code. Perform the following tests:
   1. Gravity Sewer Testing:
      a. Low Pressure Air Test.
      b. Infiltration Test.
   2. Deflection Testing of Plastic Piping.
   3. Manhole Testing: Vacuum Test.
   4. Notify Engineer 72 hours in advance of test and have witness test.

D. Soil Compaction Testing: In accordance with Section 31 23 17.

E. When tests indicate Work does not meet specified requirements, remove work, replace, and retest.

3.7 PROTECTION OF FINISHED WORK

A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.
   1. Take care not to damage or displace installed pipe and joints during construction of pipe supports, backfilling, testing, and other operations.
   2. Repair or replace pipe that is damaged or displaced from construction operations.

END OF SECTION

SECTION 33 42 13
PIPE CULVERTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Pipe culverts.
2. Joints and accessories.
3. Bedding.
4. Slope protection at pipe end.

B. Related Sections:
1. Section 31 23 17 - Trenching: Excavating and backfilling for culvert piping.
2. Section 31 37 00 – Riprap: Erosion protection at culvert ends.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:
1. AASHTO M36 – Corrugated Steel Pipe, Metallic Coated, for Sewers and Drains.
2. AASHTO M190 – Bituminous-Coated Corrugated Metal Culvert Pipe and Pipe Arches.
3. AASHTO M196 – Corrugated Aluminum Pipe for Sewers and Drains.
4. AASHTO M294 - Specification for Corrugated Polyethylene Pipe, 305- to 915-mm (12- to 36-In.) Diameter.
5. AASHTO M294 - Corrugated Polyethylene Pipe

B. ASTM International:
1. ASTM A929 - Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe.
2. ASTM C14 - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
3. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
4. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
5. ASTM C506 - Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe.
6. ASTM C507 - Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe.
7. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
8. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
9. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

C. SCDOT Standard Specifications:
1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
B. Product Data: Submit data on pipe, fittings and accessories.

C. Manufacturer's Installation Instructions: Submit special procedures required to install Products specified.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents:
1. Accurately record actual locations of pipe runs, connections, and invert elevations.
2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

B. Operation and Maintenance Data: Procedures for submittals.

PART 2 PRODUCTS

2.1 STORM DRAINAGE PIPING

A. Reinforced Concrete Pipe (RCP): ASTM C76, bell and spigot or tongue and groove ends.
1. Pipe Class: Class III with Wall Type B, unless otherwise shown on Drawings.
2. Fittings: Reinforced concrete.
3. Joints: ASTM C443, rubber compression gasket.

B. Reinforced Non-Circular Concrete Pipe:
1. Reinforced Concrete Arch Pipe: ASTM C506, Class A-III.
2. Reinforced Horizontal Elliptical Concrete Pipe: ASTM C507, Class HE-II.
3. Reinforced Vertical Elliptical Pipe: ASTM C507, Class VE-III.

C. HDPE Corrugated Polyethylene Pipe: AASHTO M294, Type S or Type D.
1. Fittings: PVC conforming to pipe specifications.
2. Joints: ASTM F477, elastomeric gaskets.

D. Corrugated Metal Pipe (CMP):

1. Steel Pipe: ASSHTO M36, Gage 16 for 6" through 48", Gage 14 for 54", Gage 12 for 60".
2. Fittings: Corrugated Steel or Aluminum to match pipe.
3. Joints: Corrugated coupling bands, galvanized steel or aluminum to match pipe, minimum 10 inches wide; connected with two neoprene "O" ring gaskets per and two galvanized steel bolts.

E. Bituminous Coated CMP: AASHTO M 190, Coated inside and out with 0.050 inch thick bituminous coating.

2.2 BEDDING AND COVER MATERIALS

A. General: Conform to Section 31 23 17 for bedding and backfill around and on top of pipe.

B. Bedding for Rigid Pipe (RCP): Clean sand, slightly silty sand, or slightly clayey sand having a Unified Soil Classification of SP, SP-SM or SP-SC.

C. Bedding for Flexible Pipe (HDPE and CMP): Clean course aggregate Gradation No. 57 conforming to Division 700 of the SCDOT Standard Specifications.

D. Cover and Fill: Conform to Section 31 23 17.

2.3 ACCESSORIES

A. Geotextile Fabric: Non-woven, non-biodegradable conforming to Division 800 of the SCDOT Standard Specifications for Type 1 Engineering Fabric.

B. Concrete: Class A Concrete conforming to Division 700 of the SCDOT Standard Specifications.
1. Compressive strength of 3,000 psi at 28 days.
2. Air entrained.
3. Water cement ratio of 0.488 with rounded aggregate and 0.532 with angular aggregate.
4. Maximum slump of 3.5 inch for vibrated concrete and 4 inch for non-vibrated concrete.
5. Minimum cement content of 564 pounds per cubic yard for vibrated concrete and 602 pounds per cubic yard for non-vibrated concrete.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

A. Remove large stones or other hard matter which could damage piping or impede consistent backfilling or compaction.

3.3 EXCAVATION AND BEDDING

A. Excavate pipe trench in accordance with Section 31 23 17.

B. Excavate to lines and grades shown on Drawings or required to accommodate installation of encasement.

C. Dewater excavations to maintain dry conditions and preserve final grades at bottom of excavation.

D. Provide sheeting and shoring in accordance with Section 31 23 17.

E. Place bedding material at trench bottom, level continuous layer not exceeding 8-inch compacted depth; compact to 95 percent per Section 31 23 17.

F. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 INSTALLATION – PIPE

A. Install in accordance with manufactures instructions and as indicated on Drawings.

B. Install plastic pipe, fittings, and accessories in accordance with ASTM D2321.

C. Seal joints watertight.

D. Begin at downstream end and progress upstream.

E. Keep pipe and fittings clean until work is completed and accepted by Engineer.

F. Lay bell and spigot pipe with bells upstream.

G. Repair surface damage to pipe with protective coating with two coats of compatible bituminous paint coating.

H. Install cover at sides and over top of pipe

3.5 PIPE ENDS

A. Place fill at pipe ends to match embankment slopes, concrete aprons, adjacent construction, end sections, or end walls as indicated on Drawings.

3.6 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Lay pipe to alignment and slope gradients noted on Drawings; with maximum variation from indicated slope of 1/8 inch in 10 feet.

C. Maximum Variation from Intended Elevation of Culvert Invert: 1/2 inch.

D. Maximum Offset of Pipe From Indicated Alignment: 1 inch.

E. Maximum Variation in Profile of Structure from Intended Position: 1 percent.

3.7 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and

balancing.

B. Request inspection prior to and immediately after placing bedding.

C. Soil Compaction Testing: In accordance with Section 31 23 17.

D. When tests indicate Work does not meet specified requirements, remove work, replace, and retest.

3.8 PROTECTION OF INSTALLED CONSTRUCTION

A. Protect pipe and bedding from damage or displacement until backfilling operation is in progress.

END OF SECTION

SECTION 33 46 00
SUBDRAINGE AND PERFORATED PIPE SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Infiltration system piping.
2. Geotextile Fabric.
3. Rock Bedding.
4. Fittings and Cleanouts.

B. Related Sections:
1. Section 31 23 17 - Trenching: Excavation, bedding, and backfill requirements for trenching required by this Section.
2. Section 33 41 00 – Storm-Utility-Drainage-Piping-SC.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials
1. AASHTO M292 – Corrugated Polyethylene Drainage Pipe.
2. AASHTO M294 – Corrugated Polyethylene Pipe.

B. ASTM International:
1. ASTM C33, Standard Specification for Concrete Aggregates.
2. ASTM D737, Standard Test Method for Air Permeability of Textile Fabrics.
3. ASTM D1784, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
4. ASTM D3034, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
5. ASTM D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
6. ASTM D3776, Standard Test Method for Mass per Unit Area (Weight) of Fabric.
7. ASTM D3786, Standard Test Method for Bursting Strength of Textile Fabrics—Diaphragm Bursting Strength Tester Method.
8. ASTM D3887, Standard Specification for Tolerances for Knitted Fabrics
9. ASTM D4491, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
10. ASTM D4533, Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
11. ASTM D4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
12. ASTM D4751, Standard Test Method for Determining the Apparent Opening Size of a Geotextile.
13. ASTM D4833, Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
14. ASTM D6241, Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products using a 50-mm Probe
15. ASTM D6707, Standard Specification for Circular-Knit Geotextile for Use in Subsurface Drainage Applications
16. ASTM F405, Standard Specification for Corrugated Polyethylene (PE) Pipe and

Fittings.

17. ASTM F477, Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

C. SCDOT Standard Specifications:
1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data for pipe and pipe accessories.

C. Manufacturer's Installation Instructions: Submit special procedures required to install products specified.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

E. Geotextile fabric.

F. Rock gradation results.

G. Polyethylene pipe and fittings (including slot perforation pattern).

H. PVC pipe and fittings (including perforation pattern).

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents:
1. Accurately record actual locations of pipe runs, connections, catch basins, cleanouts, and invert elevations.
2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with SCDOT Standard Specifications.

B. Maintain one copy of document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum 5 years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum 5 years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Block individual and stockpiled pipe lengths to prevent moving.

C. Do not place pipe or pipe materials on private property or in areas obstructing pedestrian or vehicle traffic.

D. Do not place pipe flat on ground. Cradle to prevent point stress.

E. Store UV sensitive materials out of direct sunlight.

F. Geotextile: During shipment and storage, the rolls of fabric shall be protected against deterioration from the sun, mud, dirt, dust, and other deleterious conditions at all times.

1.8 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate Work with local storm drain authority.

C. Notify affected utility companies minimum of 72 hours prior to construction.

PART 2 PRODUCTS

2.1 GEOTEXTILE FABRIC

A. The fabric shall have complete resistance to deterioration from ambient temperatures, acid, and alkaline conditions, and shall be indestructible to microorganisms and insects. The material shall be resistant to short-term (until placement) deterioration by ultraviolet light or protected until placement, as recommended by the manufacturer, such that no deterioration occurs.

B. Fibers used in the manufacture of geotextiles, and the threads used in joining geotextiles by sewing, shall consist of long chain synthetic polymers composed of at least eighty five percent (85%) by weight polyolefins, polyesters, or polyamides. They shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including selvedges.

C. The property values shown below are not design values, but represent the minimum accepted physical characteristics of the geotextile required. The number represents a value to be confirmed by the manufacturer. These values represent minimum average roll values (for example, any roll tested shall meet or exceed the minimum values in the table).

Property	Value	Test Method
Grab Strength	120 lbs.	ASTM D4632
Grab Tensile Elongation	55%	ASTM D4632
Burst Strength	225 psi	ASTM D3786
Puncture Resistance	65 lbs.	ASTM D4833
Trapezoid Tear Strength	50 lbs.	ASTM D4533
Apparent Opening Size	70, U.S. Standard Sieve	ASTM D4751
Permittivity	1.7 $sec.^{-1}$	ASTM D4491
Water Flow Rate	140 $gal./min./ft.^2$	ASTM D4491

D. Geotextile fabric for pipe underdrains shall be Mirafi 140N or equivalent.

2.3 DRAIN SLEEVE

Property	Value	Test Method
Weight	3.5 – 3.9 $oz./yd^2$.	ASTM D3776
Thickness	0.040 in.	
Burst Strength (min)	120 psi	ASTM D3887
Puncture Resistance (min)	180 lbs.	ASTM D6241
Air Permeability	700 $ft.^3/ft.^2/min.$	ASTM D737
Apparent Opening Size	30, U.S. Standard Sieve	ASTM D4751
Permittivity (min)	2.4 $sec.^{-1}$	ASTM D4491
Water Flow Rate	300 $gal/min/ft.^2$ (2" Constant Head)	ASTM D4491

2.3 ROCK BEDDING

A. Unless otherwise shown in the DRAWINGS, rock shall consist of dense, clean, uniformly graded material with a maximum size of two (2) inches and less than five percent (5%) passing the three-eighths inch (3/8") sieve. Coarse concrete aggregate meeting the requirements of ASTM C33 No. 4 may be used.

2.4 HDPE PIPE AND FITTINGS

A. ADS Heavy Duty Pipe meeting ASTM F405 with slotted or circular perforations providing a minimum inlet area as required by AASHTO M252 or AASTO M294 Class 2 perforations.. The slotted perforation pattern shall be in accordance with AASHTO M252 or AASHTO M294 Class 2 perforations providing a flow rate for six-inch (6") diameter pipe of ninety four hundredths (0.94) GPM at a one-foot (1') pressure head. The pipe is available in ten-foot (10') joints, one hundred (100), and one thousand five hundred (1,500) linear foot rolls. The pipe shall include a factory- installed drain sleeve that meets the requirements of ASTM D6707 (ADS Drain-Sleeve or approved equal).
B. HDPE pipe and fittings shall be made in accordance with ASTM F405.
C. HDPE pipe shall be Type S or approved equal.

2.5 PVC PIPE AND FITTINGS

A. Specifications and Dimensions:

1. PVC pipe and fittings shall be made in accordance with ASTM D1784.

2. The pipe shall be designed, manufactured, tested, inspected and marked in accordance with the provisions of this SPECIFICATION and ASTM D3034. The minimum wall thickness shall be SDR 35.

3. Nominal pipe lengths of pipe shall be twenty (20) feet, with shorter lengths provided as required by DRAWINGS, alignment, and grade.

B. Joint Type:

1. Pipe joints shall be made using an integral bell with an elastomeric gasket push- on type joint. The joint shall comply with the requirements of ASTM D3212.

2. Gaskets shall meet the requirements of ASTM F477.

3. Solvent-cement joints are strictly prohibited.

C. Perforations:
1. PVC piping shown on the DRAWINGS to be perforated shall be perforated to the pattern shown on the DRAWINGS. If no pattern is shown on the DRAWINGS, four (4) one-quarter inch (1/4") diameter holes shall be provided at six-inch (6") centers at the quarter points of the pipe. No perforation shall be made within six (6) inches from either end of the pipe.

2. Laterals, drain lines away from the structure, and the top ten (10) feet of cleanout risers shall have a solid wall.

PART 3 EXECUTION

3.1 TRENCHING

A. The underdrain shall be trenched into the native soil a maximum of six (6) inches if so shown on the DRAWINGS to the grades shown on the DRAWINGS. The trenches shall slope uniformly at the grade shown on the DRAWINGS.

3.2 GEOTEXTILE FABRIC

A. All perforated pipe shall be wrapped with geotextile fabric.
B. Perforated pipe in cleanout risers shall be wrapped in geotextile fabric. Suitable means shall be found to seal the seam and maintain the position of the fabric during backfilling.
C. Care shall be taken not to tear any geotextile fabric during backfilling.

3.3 ROCK

A. Rock shall be placed on the geotextile fabric to the depth shown prior to placement of the underdrain pipe. After the pipe is in place, rock shall be placed along and over the top of the pipe in a manner that shall not damage the pipe.

3.4 HDPE PIPE AND FITTINGS

A. The pipe shall be installed in accordance with the manufacturer's written instructions, a copy of which shall be maintained on site during pipe installation.

3.5 PVC PIPE AND FITTINGS

A. General: When laying PVC pipe out on a curve, the joints may be deflected up to seventy five percent (75%) of the maximum value permitted by the manufacturer of the pipe. Tighter curves shall be made by either using shorter lengths of pipe or by using manufactured bends.
B. Perforated Pipe: Perforated pipe shall be placed in the rock bedding as shown on the DRAWINGS.
C. Solid Pipe: Solid PVC pipe shall be placed on six (6) inches of sand bedding, unless the native soil is capable of providing uniform support as approved by ENGINEER or shown on the DRAWINGS.

3.6 CLEAN-OUTS

A. The clean-out risers shall be protected from damage during the backfilling operations.
B. The ring and cap shall be secured in place with a reinforced concrete collar as shown on the DRAWINGS.

END OF SECTION

APPENDIX 1 - EXISTING HAZARDOUS MATERIAL INFORMATION

1.1 EXISTING HAZARDOUS MATERIAL INFORMATION

A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information, but are not a warranty of existing conditions. This Document and its attachments are not part of the Contract Documents.

B. An existing asbestos report for Project, prepared by Phoenix EnviroCorp, dated July 5, 2023 & July 7, 2023 is available for viewing as appended to this Document.

C. Related Requirements:

1. Section 024119 "Selective Structure Demolition" for notification requirements if materials suspected of containing hazardous materials are encountered.

END OF DOCUMENT 003126

ASBESTOS INSPECTION REPORT

Client:	Rein Mungo Coastal Carolina University Facilities Maintenance P.O. Box 261954 Conway, SC 29528-6054 Cell Phone Number: 843-222-2577 Office Phone Number: 843-349-2577
Site Location:	1041 Highway 544 Conway, SC 29526
Inspection Date:	July 5, 2023 & July 7, 2023
Report Date:	July 12, 2023
Inspected By:	Tommie Green SC Consultant/MP-00184 Phoenix EnviroCorp 4020 Shipyard Boulevard Wilmington, NC 28403 (910) 397-0370
Phoenix EnviroCorp Job Number:	21-23-081-AB-I and 21-23-081A-AB-I

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SECTION 1.0 - INTRODUCTION

On July 5, 2023, and July 7, 2023, Phoenix EnviroCorp (PEC) representative Tommie Green, South Carolina Consultant/Building Inspector# MP-00184 conducted an asbestos inspection at 107 Citadel Drive, Conway, SC. The purpose of this inspection was to sample suspect Asbestos-Containing Materials (ACM) prior to demolition.

The subject property is a one-story building on a slab, with brick siding (i.e., clubhouse). The clubhouse is attached to the golf cart storage building, which was not part of this inspection. The property measures approximately forty-two (4,200) square feet. Due to rain and thunderstorms on July 5, 2023, the exterior inspection was performed on July 7, 2023.

The interior building materials consisted of carpet, vinyl sheet flooring, ceramic tiles, drywall, plaster, vinyl wallpaper, textured ceilings, fiberglass insulation, and ceiling panels. The exterior consisted of brick siding, a flat and shingle roof, and HVAC duct insulation on the roof.

The collected samples were placed into individual sample containers, sealed, and assigned a unique identification number at the time of collection. The sample information was logged onto a chain of custody/laboratory request form and submitted to a third-party laboratory for analysis.

The completion of this survey included the collection of sixty-two (62) bulk samples. The analysis of these samples was performed by Polarized Light Microscopy (PLM) utilizing dispersion staining techniques. In addition, per South Carolina asbestos regulations, all non-friable organically bound (NOB) materials found to contain less than one percent (<1%) asbestos per PLM analysis are required to be re-analyzed utilizing Transmission Electron Microscopy (TEM) analysis. Any multi-layered samples/ heterogeneous samples analyzed were first separated into sub-samples and analyzed separately per EPA protocol. Positive stop instructions were issued for all homogeneous sample materials that previously tested positive for asbestos content. Upon completion of analysis, a total of one hundred-four (104) samples were analyzed via PLM and twenty (20) NOB materials were analyzed via TEM. The results are enclosed in this report.

SECTION 2.0 - ASBESTOS INSPECTION

2.1 – Homogeneous Areas and Materials

Prior to conducting the survey, a walk through and visual inspection was conducted to determine Homogeneous Areas (HGAs) and sampling locations. Homogeneous areas were denoted by the functional space within the structure, and by their color, texture, and date of installation.

2.2 – Suspect Asbestos-Containing Material Classification

All suspect ACMs are classified as Surfacing Materials (SM), Thermal System Insulation (TSI), or Miscellaneous Materials (MM). In addition, the homogeneous materials are identified as friable or non-friable suspect asbestos-containing materials. Friable materials are defined as those materials that can be pulverized or reduced to powder by hand pressure.

2.3 – Accessibility and Potential for Disturbance

The asbestos inspector is required to make a determination of the accessibility and potential for disturbance of asbestos-containing materials. The accessibility and potential for disturbance are rated as

high, moderate, and low. All asbestos containing materials will have a high potential for disturbance if not removed prior to demolition.

2.4 – Required Amount of Asbestos Bulk Samples

Per South Carolina asbestos regulations, SM that measures one thousand square feet/linear feet or less requires three asbestos bulk samples, between one thousand to five thousand square/linear feet requires five asbestos bulk samples, and greater than five thousand square feet/linear feet requires seven asbestos bulk samples. All homogeneous TSI and MM require at least three asbestos bulk samples. In addition, all non-friable organically bound (NOB) materials found to contain less than one percent (<1%) asbestos per PLM analysis requires Transmission Electron Microscopy (TEM) analysis.

2.5 – Definition of an Asbestos-Containing and Non-Asbestos Containing Material

A homogeneous material is determined to be asbestos containing if the amount of asbestos present is greater than one percent (>1%). A homogeneous material is not considered to be asbestos containing if the amount of asbestos present is one percent or less (≤1%).

SECTION 3.0 – EXECUTIVE SUMMARY

3.1 – Homogeneous Materials Identified as Asbestos-Containing

The following is a list of the ACMs, sample numbers, the number of samples collected for each material, homogeneous areas, friable or non-friable descriptions and material types, measurement of the materials, physical description of the ACMs, and the PLM and TEM results:

Plaster walls/ceilings
Sample Numbers: 070523-TG-29 through 070523-TG-35 (seven PLM samples)

- HGA-9- Friable SM – Assumed over three thousand (3,000) square feet. **Result: White/off-white surface material = 2% Chrysotile Asbestos (PLM analysis)**

Shingle roof system
Sample Numbers: 070723-TG-10 through 070723-TG-12 (three PLM samples and one TEM sample)

- HGA-17 – Non-friable MM – Approximately one thousand, five hundred twenty (1,520) square feet **Result: Tar under shingle roof = 2% Chrysotile Asbestos (PLM and TEM analysis)**

3.2 – Homogeneous Materials Identified as Non-Asbestos-Containing

The following is a list of the sample numbers, the number of samples collected for each material, homogeneous areas, friable or non-friable descriptions and material types, measurement of the materials, physical description of the suspect ACMs, and PLM and TEM results:

Mastic associated with black base cove
Sample Numbers: 070523-TG-01 through 070523-TG-03 (three PLM samples and two TEM samples)

- HGA-01 – Non-friable MM – Approximately four hundred twelve (412) linear feet of base cove. **Results: None Detected**

Mastic associated with multicolored carpet
Sample Numbers: 070523-TG-04 through 070523-TG-06 (three PLM samples and one TEM sample)

- HGA-02 – Non-friable MM – Approximately three thousand, five hundred eighty-four (3,584) square feet of carpet. **Results: None Detected**

Leveling compound associated with green carpet
Sample Numbers: 070523-TG-07 through 070523-TG-09 (three PLM samples)
- HGA-03 – Friable MM – Approximately one hundred seventy (170) square feet of carpet. **Results: None Detected**

Vinyl flooring and associated mastic located in the women's restroom
Sample Numbers: 070523-TG-10 through 070523-TG-12 (three PLM samples and two TEM samples)
- HGA-04 – Non-friable MM – Approximately one hundred (100) square feet of vinyl flooring. **Results: None Detected**

Pink ceramic floor system located in the women's restroom
Sample Numbers: 070523-TG-13 through 070523-TG-15 (three PLM samples)
- HGA-05 – Non-friable MM – Approximately one hundred fifteen (115) square feet of pink ceramic floor tile. **Results: None Detected**

Pink ceramic wall system located in the women's restroom
Sample Numbers: 070523-TG-16 through 070523-TG-18 (three PLM samples)
- HGA-06 – Non-Friable MM – Approximately one hundred four (104) square feet of pink ceramic wall system. **Results: Grout = < 1% Chrysotile Asbestos**

Multilayered ceramic floor tile system located in the men's restroom
Sample Numbers: 070523-TG-19 through 070523-TG-21 (three PLM samples and one TEM sample)
- HGA-07 – Non-friable MM – Approximately one hundred (100) square feet of multilayered ceramic floor tile system. **Results: None Detected**

Drywall/joint compound
Sample Numbers: 070523-TG-22 through 070523-TG-28 (seven PLM samples)
- HGA-08 – Friable SM – Assumed greater than three thousand (3,000) square feet. **Results: None Detected**

Vinyl wallpaper (two layers) located in the hallway to the women's bathroom
Sample Numbers: 070523-TG-36 through 070523-TG-38 (three PLM samples and two TEM samples)
- HGA-10 – Non-friable MM – Approximately one hundred eight (108) square feet (two layers). **Results: None Detected**

Ceiling panels located in the dining room
Sample Numbers: 070523-TG-39 through 070523-TG-41 (three PLM samples)
- HGA-11 – Friable MM – Approximately three hundred sixty-five (365) square feet. **Results: None Detected**

Wavey ceiling texture
Sample Numbers: 070523-TG-42 through 070523-TG-44 (three PLM samples)
- HGA-12 – Friable SM – Approximately three hundred twenty-four (324) square feet. **Results: None Detected**

Popcorn ceiling texture
Sample Numbers: 070523-TG-45 through 070523-TG-47 (three PLM samples)

- HGA-13 – Friable SM – Approximately two hundred sixty-seven (267) square feet. **Result: None Detected**

Off-white HVAC duct insulation located on the roof
Sample Numbers: 070723-TG-01 through 070723-TG-03 (three PLM samples and two TEM samples)

- HGA-14 – Non-friable TSI – Approximately one hundred twenty (120) linear feet. **Result: None detected**

Black HVAC duct insulation located on the roof
Sample Numbers: 070723-TG-04 through 070723-TG-06 (three PLM samples and three TEM samples)

- HGA-15 – Non-friable TSI – Approximately fifty-four (54) square feet. **Results: None Detected**

Roof flashing
Sample Numbers: 070723-TG-07 through 070723-TG-09 (three PLM samples and one TEM sample)

- HGA-16 – Non-friable MM – Approximately four hundred thirty-two (432) linear feet. **Results: None Detected**

Flat roof system
Sample Numbers: 070723-TG-13 through 070723-TG-15 (three PLM samples and two TEM samples)

- HGA-18 – Non-friable MM – Approximately three thousand, nine hundred sixty (3,960) square feet. **Results: None Detected**

3.3 – Conclusions

The assumed over three thousand (3,000) square feet of the asbestos-containing surface material associated with plaster walls/ceilings located in various locations throughout the building shall be removed prior to demolition, as well as the approximately one thousand five hundred twenty (1,520) square feet of asbestos-containing roofing materials (i.e., tar located under shingles).

The removal of asbestos containing materials shall be conducted by South Carolina asbestos accredited personnel.

Should you have any questions, please do not hesitate to call.

Thank you,



Tommie Green
Asbestos Inspector
SC Consultant/Building Inspector# MP-00184

Phoenix EnviroCorp

Appendix A – Laboratory Analytical Results, Chain of Custodies, and Laboratory Credentials

Phoenix EnviroCorp
4020 SHIPYARD BLVD.
WILMINGTON, NC 28403

CHAIN OF CUSTODY

EUROFINS CEI, INC
SAMPLES ACCEPTED
STR

47

T231436

LABORATORY TEST REQUEST

CONTACT: Tommie Green	PHONE: (910) 397-0370 FAX: (910) 313-6094 EMAIL: kmgreen@phoenixenvirocorp.com	DATE SAMPLED: B23143897/ 7/5/2023
PEC Job #: 21-23-081-AB-I	CLIENT'S JOB NAME: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526	

SAMPLE TYPE:	NUMBER OF SAMPLES:	TURN AROUND TIME SPECIFIED:
Asbestos Bulk (PLM)	47	____ 2 Hr __X__ 6 Hr ____ 24 Hr ____ 48 Hr ____ 3-5 Day
TEM	13	

SPECIAL INSTRUCTIONS: 1.) Stop at first positive for each homogeneous area (HGA). 2.) List positive stops on analysis form. 3.) Separate all layers prior to analysis. 4.) Do not analyze ceramic tile; analyze any associated mastic, grout, mortar, backerboard, etc. . 5.) Do not analyze fiberglass. 6.) Confirm negative results for non-friable, organically bound material with one (1) TEM analysis per HGA. 7.) Any drywall or joint compound HGA that is > 1%, but < 5% shall be re-analyzed (separately) utilizing EPA 400 point count method. 8.) Please email results.

Sample #	Sample Area	Sample Date	HGA	Sq. Footage	Lab Analysis Requested
070523-TG-01	Mastic assoc with black base cove	07/05/23	1	412 LF	PLM
070523-TG-02	Mastic assoc with black base cove	07/05/23	1	412 LF	PLM
070523-TG-03	Mastic assoc with black base cove	07/05/23	1	412 LF	PLM
070523-TG-04	Mastic assoc with multicolored carpet	07/05/23	2	3,584	PLM
070523-TG-05	Mastic assoc with multicolored carpet	07/05/23	2	3,584	PLM
070523-TG-06	Mastic assoc with multicolored carpet	07/05/23	2	3,584	PLM
070523-TG-07	Leveling compouned assoc with green carpet	07/05/23	3	170	PLM
070523-TG-08	Leveling compouned assoc with green carpet	07/05/23	3	170	PLM
070523-TG-09	Leveling compouned assoc with green carpet	07/05/23	3	170	PLM
070523-TG-10	Vinyl flooring/assoc mastic located in the women's restroom	07/05/23	4	100	PLM
070523-TG-11	Vinyl flooring/assoc mastic located in the women's restroom	07/05/23	4	100	PLM
070523-TG-12	Vinyl flooring/assoc mastic located in the women's restroom	07/05/23	4	100	PLM
070523-TG-13	Pink ceramic floor system located in the women's restroom	07/05/23	5	115	PLM
070523-TG-14	Pink ceramic floor system located in the women's restroom	07/05/23	5	115	PLM
070523-TG-15	Pink ceramic floor system located in the women's restroom	07/05/23	5	115	PLM
070523-TG-16	Pink ceramic wall system located in the women's restroom	07/05/23	6	104	PLM
070523-TG-17	Pink ceramic wall system located in the women's restroom	07/05/23	6	104	PLM
070523-TG-18	Pink ceramic wall system located in the women's restroom	07/05/23	6	104	PLM
070523-TG-19	Multi-layer ceramic tile floor system located in the men's restroom	07/05/23	7	100	PLM
070523-TG-20	Multi-layer ceramic tile floor system located in the men's restroom	07/05/23	7	100	PLM

CHAIN OF CUSTODY RECORD

DATE	CONDITION OF SAMPLE	SAMPLES RECEIVED BY	SAMPLES RELEASED BY
7/5/2023	SEALED/GOOD	SIGNATURE STR 7/7/23 9:40	SIGNATURE

8177.4374.5390

Phoenix EnviroCorp
4020 SHIPYARD BLVD.
WILMINGTON, NC 28403

CHAIN OF CUSTODY

LABORATORY TEST REQUEST

CONTACT: Tommie Green	PHONE: (910) 397-0370 FAX: (910) 313-6094 EMAIL: kmgreen@phoenixenvirocorp.com	DATE SAMPLED: 7/5/2023
PEC Job #: 21-23-081-AB-I	CLIENT'S JOB NAME: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526	

SAMPLE TYPE:	NUMBER OF SAMPLES:	TURN AROUND TIME SPECIFIED:
Asbestos Bulk (PLM)	47	____ 2 Hr __X__ 6 Hr ____ 24 Hr ____ 48 Hr ____ 3-5 Day
TEM	13	

SPECIAL INSTRUCTIONS: 1.) Stop at first positive for each homogeneous area (HGA). 2.) List positive stops on analysis form. 3.) Separate all layers prior to analysis. 4.) Do not analyze ceramic tile; analyze any associated mastic, grout, mortar, backerboard, etc. . 5.) Do not analyze fiberglass. 6.) Confirm negative results for non-friable, organically bound material with one (1) TEM analysis per HGA. 7.) Any drywall or joint compound HGA that is > 1%, but < 5% shall be re-analyzed (separately) utilizing EPA 400 point count method. 8.) Please email results.

Sample #	Sample Area	Sample Date	HGA	Sq. Footage	Lab Analysis Requested
070523-TG-21	Multi-layer ceramic tile floor system located in the men's restroom	07/05/23	7	100	PLM
070523-TG-22	Drywall/joint compound	07/05/23	8		PLM
070523-TG-23	Drywall/joint compound	07/05/23	8		PLM
070523-TG-24	Drywall/joint compound	07/05/23	8		PLM
070523-TG-25	Drywall/joint compound	07/05/23	8		PLM
070523-TG-26	Drywall/joint compound	07/05/23	8		PLM
070523-TG-27	Drywall/joint compound	07/05/23	8		PLM
070523-TG-28	Drywall/joint compound	07/05/23	8		PLM
070523-TG-29	Plaster walls/ceilings	07/05/23	9		PLM
070523-TG-30	Plaster walls/ceilings	07/05/23	9		PLM
070523-TG-31	Plaster walls/ceilings	07/05/23	9		PLM
070523-TG-32	Plaster walls/ceilings	07/05/23	9		PLM
070523-TG-33	Plaster walls/ceilings	07/05/23	9		PLM
070523-TG-34	Plaster walls/ceilings	07/05/23	9		PLM
070523-TG-35	Plaster walls/ceilings	07/05/23	9		PLM
070523-TG-36	Vinyl wallpaper (two layers) located in the women's hallway bathroom	07/05/23	10	128	PLM
070523-TG-37	Vinyl wallpaper (two layers) located in the women's hallway bathroom	07/05/23	10	128	PLM
070523-TG-38	Vinyl wallpaper (two layers) located in the women's hallway bathroom	07/05/23	10	128	PLM
070523-TG-39	Ceiling panels locate in the dining room	07/05/23	11	365	PLM
070523-TG-40	Ceiling panels locate in the dining room	07/05/23	11	365	PLM

CHAIN OF CUSTODY RECORD

DATE	CONDITION OF SAMPLE	SAMPLES RECEIVED BY	SAMPLES RELEASED BY
7/5/2023	SEALED/GOOD	SIGNATURE	SIGNATURE

Phoenix EnviroCorp
4020 SHIPYARD BLVD.
WILMINGTON, NC 28403

CHAIN OF CUSTODY

LABORATORY TEST REQUEST

CONTACT: Tommie Green	PHONE: (910) 397-0370 FAX: (910) 313-6094 EMAIL: kmgreen@phoenixenvirocorp.com	DATE SAMPLED: 7/5/2023
PEC Job #: 21-23-081-AB-I	CLIENT'S JOB NAME: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526	

SAMPLE TYPE:	NUMBER OF SAMPLES:	TURN AROUND TIME SPECIFIED:
Asbestos Bulk (PLM) TEM	47 13	____ 2 Hr __X__ 6 Hr ____ 24 Hr ____ 48 Hr ____ 3-5 Day

SPECIAL INSTRUCTIONS: 1.) Stop at first positive for each homogeneous area (HGA). 2.) List positive stops on analysis form. 3.) Separate all layers prior to analysis. 4.) Do not analyze ceramic tile; analyze any associated mastic, grout, mortar, backerboard, etc. . 5.) Do not analyze fiberglass. 6.) Confirm negative results for non-friable, organically bound material with one (1) TEM analysis per HGA. 7.) Any drywall or joint compound HGA that is > 1%, but < 5% shall be re-analyzed (separately) utilizing EPA 400 point count method. 8.) Please email results.

Sample #	Sample Area	Sample Date	HGA	Sq. Footage	Lab Analysis Requested
070523-TG-41	Ceiling panels locate in the dining room	07/05/23	11	365	PLM
070523-TG-42	Wavey ceiling texture	07/05/23	12	324	PLM
070523-TG-43	Wavey ceiling texture	07/05/23	12	324	PLM
070523-TG-44	Wavey ceiling texture	07/05/23	12	324	PLM
070523-TG-45	Popcorn ceiling texture	07/05/23	13	267	PLM
070523-TG-46	Popcorn ceiling texture	07/05/23	13	267	PLM
070523-TG-47	Popcorn ceiling texture	07/05/23	13	267	PLM

CHAIN OF CUSTODY RECORD

DATE	CONDITION OF SAMPLE	SAMPLES RECEIVED BY	SAMPLES RELEASED BY
7/5/2023	SEALED/GOOD	SIGNATURE	SIGNATURE

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July 7, 2023

Phoenix EnviroCorp
4020 Shipyard Boulevard
Wilmington, NC 28403

CLIENT PROJECT: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23 -081-AB-I
CEI LAB CODE: B2314389

Dear Customer:

Enclosed are asbestos analysis results for PLM Bulk samples received at our laboratory on July 7, 2023. The samples were analyzed for asbestos using polarizing light microscopy (PLM) per the EPA 600 Method.

Sample results containing >1% asbestos are considered asbestos-containing materials (ACMs) per EPA regulatory requirements. The detection limit for the EPA 600 Method is <1% asbestos by weight as determined by visual estimation.

Thank you for your business and we look forward to continuing good relations.

Kind Regards,

Tianbao Bai, Ph.D., CIH
Laboratory Director

NVLAP® TESTING
NVLAP LAB CODE 101768-0

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ASBESTOS ANALYTICAL REPORT
By: Polarized Light Microscopy

Prepared for

Phoenix EnviroCorp

CLIENT PROJECT:	Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081-AB-I
LAB CODE:	B2314389
TEST METHOD:	EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020
REPORT DATE:	07/07/23
TOTAL SAMPLES ANALYZED:	38
# SAMPLES >1% ASBESTOS:	1

730 SE Maynard Road • Cary, NC 27511 • 919.481.1413

Asbestos Report Summary

By: POLARIZING LIGHT MICROSCOPY

PROJECT: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081-AB-I

LAB CODE: B2314389

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

Client ID	Layer	Lab ID	Color	Sample Description	ASBESTOS %
070523-TG-01		B2314389.01	Cream	Mastic	None Detected
070523-TG-02		B2314389.02	Cream,Brown	Mastic	None Detected
070523-TG-03		B2314389.03		Sample Submitted for TEM Analysis	
070523-TG-04		B2314389.04	Yellow	Mastic	None Detected
070523-TG-05		B2314389.05	Yellow	Mastic	None Detected
070523-TG-06		B2314389.06		Sample Submitted for TEM Analysis	
070523-TG-07		B2314389.07	White	Leveling Compound	None Detected
070523-TG-08		B2314389.08	White	Leveling Compound	None Detected
070523-TG-09		B2314389.09	White	Leveling Compound	None Detected
070523-TG-10		B2314389.10A	Gray,Black	Vinyl Flooring	None Detected
		B2314389.10B	Gray,Yellow	Mastic	None Detected
070523-TG-11		B2314389.11A	Gray,Black	Vinyl Flooring	None Detected
		B2314389.11B	Gray,Yellow	Mastic	None Detected
070523-TG-12		B2314389.12A		Sample Submitted for TEM Analysis	
		B2314389.12B		Sample Submitted for TEM Analysis	
070523-TG-13	Layer 1	B2314389.13	White	Grout	None Detected
	Layer 2	B2314389.13	White	Mortar	None Detected
070523-TG-14	Layer 1	B2314389.14	White	Grout	None Detected
	Layer 2	B2314389.14	White	Mortar	None Detected
070523-TG-15	Layer 1	B2314389.15	White	Grout	None Detected
	Layer 2	B2314389.15	White	Mortar	None Detected
070523-TG-16	Layer 1	B2314389.16	White	Grout	Chrysotile <1%
	Layer 2	B2314389.16	White	Mortar	None Detected
070523-TG-17	Layer 1	B2314389.17	White	Grout	Chrysotile <1%
	Layer 2	B2314389.17	White	Mortar	None Detected
070523-TG-18	Layer 1	B2314389.18	White	Grout	Chrysotile <1%
	Layer 2	B2314389.18	White	Mortar	None Detected
070523-TG-19	Layer 1	B2314389.19	White	Grout	None Detected

Asbestos Report Summary

By: POLARIZING LIGHT MICROSCOPY

PROJECT: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081-AB-I

LAB CODE: B2314389

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

Client ID	Layer	Lab ID	Color	Sample Description	ASBESTOS %
	Layer 2	B2314389.19	White	Mortar	None Detected
	Layer 3	B2314389.19	Gray	Mortar	None Detected
	Layer 4	B2314389.19	Off-white,Pink	Mortar	None Detected
	Layer 5	B2314389.19	Yellow	Mastic	None Detected
070523-TG-20	Layer 1	B2314389.20	White	Grout	None Detected
	Layer 2	B2314389.20	White	Mortar	None Detected
	Layer 3	B2314389.20	Gray	Mortar	None Detected
	Layer 4	B2314389.20	Off-white,Pink	Mortar	None Detected
	Layer 5	B2314389.20	Yellow	Mastic	None Detected
070523-TG-21	Layer 1	B2314389.21	White	Grout	None Detected
	Layer 2	B2314389.21	White	Mortar	None Detected
	Layer 3	B2314389.21	Gray	Mortar	None Detected
	Layer 4	B2314389.21	Off-white,Pink	Mortar	None Detected
	Layer 5	B2314389.21		Sample Submitted for TEM Analysis	
	Layer 6	B2314389.21	Clear	Caulking	None Detected
070523-TG-22	Layer 1	B2314389.22	White	Joint Compound	None Detected
	Layer 2	B2314389.22	White,Brown	Drywall	None Detected
070523-TG-23	Layer 1	B2314389.23	White	Joint Compound	None Detected
	Layer 2	B2314389.23	White,Brown	Drywall	None Detected
070523-TG-24	Layer 1	B2314389.24	White	Joint Compound	None Detected
	Layer 2	B2314389.24	White,Brown	Drywall	None Detected
070523-TG-25	Layer 1	B2314389.25	White	Joint Compound	None Detected
	Layer 2	B2314389.25	White,Brown	Drywall	None Detected
070523-TG-26	Layer 1	B2314389.26	White	Joint Compound	None Detected
	Layer 2	B2314389.26	White,Brown	Drywall	None Detected
070523-TG-27	Layer 1	B2314389.27	White	Joint Compound	None Detected
	Layer 2	B2314389.27	White,Brown	Drywall	None Detected
070523-TG-28	Layer 1	B2314389.28	White	Joint Compound	None Detected
	Layer 2	B2314389.28	White,Brown	Drywall	None Detected
070523-TG-29		B2314389.29A	White	Caulking	None Detected

Asbestos Report Summary

By: POLARIZING LIGHT MICROSCOPY

PROJECT: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081-AB-I

LAB CODE: B2314389

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

Client ID	Layer	Lab ID	Color	Sample Description	ASBESTOS %
	Layer 1	B2314389.29B	White	Plaster Skim Coat	None Detected
	Layer 2	B2314389.29B	Gray	Plaster Base Coat	None Detected
070523-TG-30	Layer 1	B2314389.30	White,Off-white	Surface Material	Chrysotile 2%
	Layer 2	B2314389.30	Off-white,Tan	Plaster	None Detected
070523-TG-31		B2314389.31		Sample Not Analyzed per COC	
070523-TG-32		B2314389.32		Sample Not Analyzed per COC	
070523-TG-33		B2314389.33		Sample Not Analyzed per COC	
070523-TG-34		B2314389.34		Sample Not Analyzed per COC	
070523-TG-35		B2314389.35		Sample Not Analyzed per COC	
070523-TG-36		B2314389.36A	White,Green	Vinyl Wallpaper	None Detected
		B2314389.36B	White	Vinyl Wallpaper	None Detected
070523-TG-37		B2314389.37A	White,Green	Vinyl Wallpaper	None Detected
		B2314389.37B	White	Vinyl Wallpaper	None Detected
070523-TG-38		B2314389.38A		Sample Submitted for TEM Analysis	
		B2314389.38B		Sample Submitted for TEM Analysis	
070523-TG-39		B2314389.39	White,Tan	Ceiling Panel	None Detected
070523-TG-40		B2314389.40	White,Tan	Ceiling Panel	None Detected
070523-TG-41		B2314389.41	White,Tan	Ceiling Panel	None Detected
070523-TG-42		B2314389.42	White	Ceiling Texture	None Detected
070523-TG-43		B2314389.43	White	Ceiling Texture	None Detected
070523-TG-44		B2314389.44	White	Ceiling Texture	None Detected
070523-TG-45		B2314389.45	White	Ceiling Texture	None Detected
070523-TG-46		B2314389.46	White	Ceiling Texture	None Detected
070523-TG-47		B2314389.47	White	Ceiling Texture	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Phoenix EnviroCorp
4020 Shipyard Boulevard
Wilmington, NC 28403

Lab Code: B2314389
Date Received: 07-07-23
Date Analyzed: 07-07-23
Date Reported: 07-07-23

Project: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081-AB-I

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous	Non-Fibrous	ASBESTOS %
070523-TG -01 B2314389.01	Mastic	Homogeneous Cream Non-fibrous Bound		100% Mastic	None Detected
070523-TG -02 B2314389.02	Mastic	Heterogeneous Cream,Brown Non-fibrous Bound		100% Mastic	None Detected
070523-TG -03 B2314389.03	Sample Submitted for TEM Analysis				
070523-TG -04 B2314389.04	Mastic	Homogeneous Yellow Non-fibrous Bound		100% Mastic	None Detected
070523-TG -05 B2314389.05	Mastic	Homogeneous Yellow Non-fibrous Bound		100% Mastic	None Detected
070523-TG -06 B2314389.06	Sample Submitted for TEM Analysis				
070523-TG -07 B2314389.07	Leveling Compound	Homogeneous White Non-fibrous Bound		100% Binder	None Detected
070523-TG -08 B2314389.08	Leveling Compound	Homogeneous White Non-fibrous Bound		100% Binder	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Phoenix EnviroCorp
4020 Shipyard Boulevard
Wilmington, NC 28403

Lab Code: B2314389
Date Received: 07-07-23
Date Analyzed: 07-07-23
Date Reported: 07-07-23

Project: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081-AB-I

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous	 Non-Fibrous	ASBESTOS %
070523-TG-09 B2314389.09	Leveling Compound	Homogeneous White Non-fibrous Bound	100%	Binder	None Detected
070523-TG-10 B2314389.10A	Vinyl Flooring	Homogeneous Gray,Black Non-fibrous Tightly Bound	100%	Vinyl	None Detected
B2314389.10B	Mastic	Heterogeneous Gray,Yellow Non-fibrous Bound	95% 5%	Mastic Binder	None Detected
070523-TG-11 B2314389.11A	Vinyl Flooring	Homogeneous Gray,Black Non-fibrous Tightly Bound	100%	Vinyl	None Detected
B2314389.11B	Mastic	Heterogeneous Gray,Yellow Non-fibrous Bound	95% 5%	Mastic Binder	None Detected
070523-TG-12 B2314389.12A	Sample Submitted for TEM Analysis				
B2314389.12B	Sample Submitted for TEM Analysis				
070523-TG-13 Layer 1 B2314389.13	Grout	Homogeneous White Non-fibrous Bound	90% 10%	Binder Silicates	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Phoenix EnviroCorp
4020 Shipyard Boulevard
Wilmington, NC 28403

Lab Code: B2314389
Date Received: 07-07-23
Date Analyzed: 07-07-23
Date Reported: 07-07-23

Project: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081-AB-I

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
Layer 2 B2314389.13	Mortar	Homogeneous White Non-fibrous Bound	<1%	Cellulose	60% 40%	Silicates Binder	None Detected
070523-TG -14 Layer 1 B2314389.14	Grout	Homogeneous White Non-fibrous Bound			90% 10%	Binder Silicates	None Detected
Layer 2 B2314389.14	Mortar	Homogeneous White Non-fibrous Bound	<1%	Cellulose	60% 40%	Silicates Binder	None Detected
070523-TG -15 Layer 1 B2314389.15	Grout	Homogeneous White Non-fibrous Bound			90% 10%	Binder Silicates	None Detected
Layer 2 B2314389.15	Mortar	Homogeneous White Non-fibrous Bound	<1%	Cellulose	60% 40%	Silicates Binder	None Detected
070523-TG -16 Layer 1 B2314389.16	Grout	Homogeneous White Non-fibrous Bound			100%	Binder	<1% Chrysotile
Layer 2 B2314389.16	Mortar	Homogeneous White Non-fibrous Bound	<1%	Cellulose	60% 40%	Silicates Binder	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Phoenix EnviroCorp
4020 Shipyard Boulevard
Wilmington, NC 28403

Lab Code: B2314389
Date Received: 07-07-23
Date Analyzed: 07-07-23
Date Reported: 07-07-23

Project: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081-AB-I

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
070523-TG-17 Layer 1 B2314389.17	Grout	Homogeneous White Non-fibrous Bound			100%	Binder	<1% Chrysotile
Layer 2 B2314389.17	Mortar	Homogeneous White Non-fibrous Bound	<1%	Cellulose	60% 40%	Silicates Binder	None Detected
070523-TG-18 Layer 1 B2314389.18	Grout	Homogeneous White Non-fibrous Bound			100%	Binder	<1% Chrysotile
Layer 2 B2314389.18	Mortar	Homogeneous White Non-fibrous Bound	<1%	Cellulose	60% 40%	Silicates Binder	None Detected
070523-TG-19 Layer 1 B2314389.19	Grout	Homogeneous White Non-fibrous Bound			90% 10%	Binder Silicates	None Detected
Layer 2 B2314389.19	Mortar	Homogeneous White Non-fibrous Bound	<1%	Cellulose	60% 40%	Silicates Binder	None Detected
Layer 3 B2314389.19	Mortar	Homogeneous Gray Non-fibrous Bound	<1%	Cellulose	60% 40%	Silicates Binder	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Phoenix EnviroCorp
4020 Shipyard Boulevard
Wilmington, NC 28403

Lab Code: B2314389
Date Received: 07-07-23
Date Analyzed: 07-07-23
Date Reported: 07-07-23

Project: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081-AB-I

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
Layer 4 B2314389.19	Mortar	Homogeneous Off-white,Pink Non-fibrous Bound	<1%	Cellulose	60% 40%	Silicates Binder	None Detected
Layer 5 B2314389.19	Mastic	Homogeneous Yellow Non-fibrous Bound			100%	Mastic	None Detected
070523-TG -20 Layer 1 B2314389.20	Grout	Homogeneous White Non-fibrous Bound			90% 10%	Binder Silicates	None Detected
Layer 2 B2314389.20	Mortar	Homogeneous White Non-fibrous Bound	<1%	Cellulose	60% 40%	Silicates Binder	None Detected
Layer 3 B2314389.20	Mortar	Homogeneous Gray Non-fibrous Bound	<1%	Cellulose	60% 40%	Silicates Binder	None Detected
Layer 4 B2314389.20	Mortar	Homogeneous Off-white,Pink Non-fibrous Bound	<1%	Cellulose	60% 40%	Silicates Binder	None Detected
Layer 5 B2314389.20	Mastic	Homogeneous Yellow Non-fibrous Bound			100%	Mastic	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Phoenix EnviroCorp
4020 Shipyard Boulevard
Wilmington, NC 28403

Lab Code: B2314389
Date Received: 07-07-23
Date Analyzed: 07-07-23
Date Reported: 07-07-23

Project: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081-AB-I

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
070523-TG -21 Layer 1 B2314389.21	Grout	Homogeneous White Non-fibrous Bound			90% 10%	Binder Silicates	None Detected
Layer 2 B2314389.21	Mortar	Homogeneous White Non-fibrous Bound	<1%	Cellulose	60% 40%	Silicates Binder	None Detected
Layer 3 B2314389.21	Mortar	Homogeneous Gray Non-fibrous Bound	<1%	Cellulose	60% 40%	Silicates Binder	None Detected
Layer 4 B2314389.21	Mortar	Homogeneous Off-white,Pink Non-fibrous Bound	<1%	Cellulose	60% 40%	Silicates Binder	None Detected
Layer 5 B2314389.21	Sample Submitted for TEM Analysis						
Layer 6 B2314389.21	Caulking	Homogeneous Clear Non-fibrous Bound			100%	Mastic	None Detected
070523-TG -22 Layer 1 B2314389.22	Joint Compound	Homogeneous White Non-fibrous Bound			55% 40% 5%	Binder Calc Carb Paint	None Detected
Layer 2 B2314389.22	Drywall	Homogeneous White,Brown Fibrous Bound	20%	Cellulose	80%	Gypsum	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Phoenix EnviroCorp
4020 Shipyard Boulevard
Wilmington, NC 28403

Lab Code: B2314389
Date Received: 07-07-23
Date Analyzed: 07-07-23
Date Reported: 07-07-23

Project: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081-AB-I

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
070523-TG-23 Layer 1 B2314389.23	Joint Compound	Homogeneous White Non-fibrous Bound			55% 40% 5%	Binder Calc Carb Paint	None Detected
Layer 2 B2314389.23	Drywall	Homogeneous White,Brown Fibrous Bound	20%	Cellulose	80%	Gypsum	None Detected
070523-TG-24 Layer 1 B2314389.24	Joint Compound	Homogeneous White Non-fibrous Bound			55% 40% 5%	Binder Calc Carb Paint	None Detected
Layer 2 B2314389.24	Drywall	Homogeneous White,Brown Fibrous Bound	20%	Cellulose	80%	Gypsum	None Detected
070523-TG-25 Layer 1 B2314389.25	Joint Compound	Homogeneous White Non-fibrous Bound			55% 40% 5%	Binder Calc Carb Paint	None Detected
Layer 2 B2314389.25	Drywall	Homogeneous White,Brown Fibrous Bound	20%	Cellulose	80%	Gypsum	None Detected
070523-TG-26 Layer 1 B2314389.26	Joint Compound	Homogeneous White Non-fibrous Bound			55% 40% 5%	Binder Calc Carb Paint	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Phoenix EnviroCorp
4020 Shipyard Boulevard
Wilmington, NC 28403

Lab Code: B2314389
Date Received: 07-07-23
Date Analyzed: 07-07-23
Date Reported: 07-07-23

Project: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081-AB-I

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
Layer 2 B2314389.26	Drywall	Homogeneous White,Brown Fibrous Bound	20%	Cellulose	80%	Gypsum	None Detected
070523-TG -27 Layer 1 B2314389.27	Joint Compound	Homogeneous White Non-fibrous Bound			55% 40% 5%	Binder Calc Carb Paint	None Detected
Layer 2 B2314389.27	Drywall	Homogeneous White,Brown Fibrous Bound	20%	Cellulose	80%	Gypsum	None Detected
070523-TG -28 Layer 1 B2314389.28	Joint Compound	Homogeneous White Non-fibrous Bound			55% 40% 5%	Binder Calc Carb Paint	None Detected
Layer 2 B2314389.28	Drywall	Homogeneous White,Brown Fibrous Bound	20%	Cellulose	80%	Gypsum	None Detected
070523-TG -29 B2314389.29A	Caulking	Heterogeneous White Non-fibrous Bound			95% 5%	Caulk Paint	None Detected
Layer 1 B2314389.29B	Plaster Skim Coat	Heterogeneous White Non-fibrous Bound			90% 5% 5%	Binder Silicates Paint	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Phoenix EnviroCorp
4020 Shipyard Boulevard
Wilmington, NC 28403

Lab Code: B2314389
Date Received: 07-07-23
Date Analyzed: 07-07-23
Date Reported: 07-07-23

Project: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081-AB-I

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
Layer 2 B2314389.29B	Plaster Base Coat	Homogeneous Gray Non-fibrous Bound	<1%	Cellulose	60% 40%	Silicates Binder	None Detected
070523-TG -30 Layer 1 B2314389.30	Surface Material	Heterogeneous White,Off-white Non-fibrous Bound			53% 40% 5%	Binder Calc Carb Paint	**2% Chrysotile**
Layer 2 B2314389.30	Plaster	Homogeneous Off-white,Tan Non-fibrous Bound	<1%	Cellulose	60% 40%	Silicates Binder	None Detected
070523-TG -31 B2314389.31	Sample Not Analyzed per COC						
070523-TG -32 B2314389.32	Sample Not Analyzed per COC						
070523-TG -33 B2314389.33	Sample Not Analyzed per COC						
070523-TG -34 B2314389.34	Sample Not Analyzed per COC						
070523-TG -35 B2314389.35	Sample Not Analyzed per COC						
070523-TG -36 B2314389.36A	Vinyl Wallpaper	Heterogeneous White,Green Fibrous Bound	45%	Cellulose	50% 5%	Vinyl Paint	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Phoenix EnviroCorp
4020 Shipyard Boulevard
Wilmington, NC 28403

Lab Code: B2314389
Date Received: 07-07-23
Date Analyzed: 07-07-23
Date Reported: 07-07-23

Project: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081-AB-I

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
B2314389.36B	Vinyl Wallpaper	Heterogeneous White Fibrous Bound	45% 	Cellulose	50% 5%	Vinyl Paint	None Detected
070523-TG -37 B2314389.37A	Vinyl Wallpaper	Heterogeneous White,Green Fibrous Bound	45%	Cellulose	50% 5%	Vinyl Paint	None Detected
B2314389.37B	Vinyl Wallpaper	Heterogeneous White Fibrous Bound	45%	Cellulose	50% 5%	Vinyl Paint	None Detected
070523-TG -38 B2314389.38A	Sample Submitted for TEM Analysis						
B2314389.38B	Sample Submitted for TEM Analysis						
070523-TG -39 B2314389.39	Ceiling Panel	Heterogeneous White,Tan Fibrous Loosely Bound	60% 20%	Cellulose Fiberglass	15% 5%	Perlite Paint	None Detected
070523-TG -40 B2314389.40	Ceiling Panel	Heterogeneous White,Tan Fibrous Loosely Bound	60% 20%	Cellulose Fiberglass	15% 5%	Perlite Paint	None Detected
070523-TG -41 B2314389.41	Ceiling Panel	Heterogeneous White,Tan Fibrous Loosely Bound	60% 20%	Cellulose Fiberglass	15% 5%	Perlite Paint	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Phoenix EnviroCorp
4020 Shipyard Boulevard
Wilmington, NC 28403

Lab Code: B2314389
Date Received: 07-07-23
Date Analyzed: 07-07-23
Date Reported: 07-07-23

Project: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081-AB-I

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous	Non-Fibrous		ASBESTOS %
070523-TG -42 B2314389.42	Ceiling Texture	Heterogeneous White Non-fibrous Bound		55% 40% 5%	Binder Calc Carb Paint	None Detected
070523-TG -43 B2314389.43	Ceiling Texture	Heterogeneous White Non-fibrous Bound		55% 40% 5%	Binder Calc Carb Paint	None Detected
070523-TG -44 B2314389.44	Ceiling Texture	Heterogeneous White Non-fibrous Bound		55% 40% 5%	Binder Calc Carb Paint	None Detected
070523-TG -45 B2314389.45	Ceiling Texture	Heterogeneous White Non-fibrous Bound		70% 25% 5%	Binder Vermiculite Paint	None Detected
070523-TG -46 B2314389.46	Ceiling Texture	Heterogeneous White Non-fibrous Bound		70% 25% 5%	Binder Vermiculite Paint	None Detected
070523-TG -47 B2314389.47	Ceiling Texture	Heterogeneous White Non-fibrous Bound		70% 25% 5%	Binder Vermiculite Paint	None Detected

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LEGEND: Non-Anth = Non-Asbestiform Anthophyllite
Non-Trem = Non-Asbestiform Tremolite
Calc Carb = Calcium Carbonate

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

REPORTING LIMIT: <1% by visual estimation

REPORTING LIMIT FOR POINT COUNTS: 0.25% by 400 Points or 0.1% by 1,000 Points

REGULATORY LIMIT: >1% by weight

Due to the limitations of the EPA 600 method, nonfriable organically bound materials (NOBs) such as vinyl floor tiles can be difficult to analyze via polarized light microscopy (PLM). EPA recommends that all NOBs analyzed by PLM, and found not to contain asbestos, be further analyzed by Transmission Electron Microscopy (TEM). Please note that PLM analysis of dust and soil samples for asbestos is not covered under NVLAP accreditation. *Estimated measurement of uncertainty is available on request.*

This report relates only to the samples tested or analyzed and may not be reproduced, except in full, without written approval by Eurofins CEI. Eurofins CEI makes no warranty representation regarding the accuracy of client submitted information in preparing and presenting analytical results. Interpretation of the analytical results is the sole responsibility of the client. Samples were received in acceptable condition unless otherwise noted. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. Government.

Information provided by customer includes customer sample ID and sample description.

ANALYST: Kathryn Wescott
Kathryn Wescott

APPROVED BY:
Tianbao Bai, Ph.D., CIH
Laboratory Director

NVLAP® TESTING
NVLAP LAB CODE 101768-0

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July 10, 2023

Phoenix EnviroCorp
4020 Shipyard Boulevard
Wilmington, NC 28403

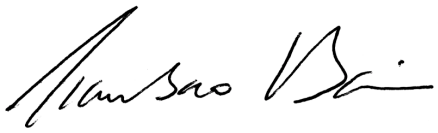
CLIENT PROJECT: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23 -081-AB-I
LAB CODE: T231436

Dear Customer:

Enclosed are asbestos analysis results for TEM bulk samples received at our laboratory on July 7, 2023. The samples were analyzed for asbestos using transmission electron microscopy (TEM) per Chatfield/EPA 600/R-93/116 Sec. 2.5.5.1 method.

Sample results containing > 1% asbestos are considered asbestos-containing materials (ACMs) per the EPA regulatory requirements. The detection limit for the TEM Chatfield/EPA 600/R-93/116 Sec. 2.5.5.1 method is <1% depending on the processed weight and constituents of the sample.

Kind Regards,



Tianbao Bai, Ph.D., CIH
Laboratory Director

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ASBESTOS ANALYTICAL REPORT
By: Transmission Electron Microscopy

Prepared for

Phoenix EnviroCorp

CLIENT PROJECT:	Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081-AB-I
LAB CODE:	T231436
TEST METHOD:	Bulk Chatfield EPA 600 / R93 / 116 Sec. 2.5.5.1
REPORT DATE:	

730 SE Maynard Road • Cary, NC 27511 • 919.481.1413

ASBESTOS BULK ANALYSIS

By: TRANSMISSION ELECTRON MICROSCOPY

Client: Phoenix EnviroCorp
4020 Shipyard Boulevard
Wilmington, NC 28403

Lab Code: T231436
Date Received: 07-07-23
Date Analyzed: 07-10-23
Date Reported:

Project: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081-AB-I

TEM BULK CHATFIELD / EPA 600 / R93 / 116 Sec. 2.5.5.1

Client ID Lab ID	Material Description	Sample Weight (g)	Organic Material %	Acid Soluble Material %	Acid Insoluble Material %	Asbestos %
070523-TG-01 T61819	Cream Mastic	0.155	44.5	9	46.5	**None Detected**
070523-TG-03 T61820	Cream, Brown Mastic	0.688	61	3.6	35.4	**None Detected**
070523-TG-06 T61821	Yellow Mastic	0.684	54.4	12.6	33	**None Detected**
070523-TG-12 T61822	Gray, Black Vinyl Flooring	0.407	34.2	64.6	1.2	**None Detected**
070523-TG-12 T61823	Gray, Yellow Mastic	0.417	88.2	10.1	1.7	**None Detected**
070523-TG-21 T61824	Yellow Mastic	0.051	23.5	43.1	33.4	**None Detected**
070523-TG-38 T61825	White, Green Vinyl Wallpaper	0.359	71.6	13.6	14.8	**None Detected**
070523-TG-38 T61826	White Vinyl Wallpaper	0.378	69	8.2	22.8	**None Detected**

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LEGEND: None

METHOD: CHATFIELD & EPA/600/R-93/116 Sec. 2.5.5.1

LIMIT OF DETECTION: Varies with the weight and constituents of the sample (<1%)

REGULATORY LIMIT: >1% by weight

This report relates only to the samples tested or analyzed and may not be reproduced, except in full, without written approval by Eurofins CEI (ECEI). ECEI makes no warranty representation regarding the accuracy of client submitted information in preparing and presenting analytical results. Interpretation of the analytical results is the sole responsibility of the client. *Estimated measurement of uncertainty is available on request and in compliance with regulatory requirements.* Samples were received in acceptable condition unless otherwise noted.

Information provided by customer includes customer sample ID, location, volume and area as well as date and time of sampling.
ECEI recommends between 0.20 and 0.50 grams of sample material for TEM bulk analysis.
Any weight below 0.10 grams is considered below protocol guidelines.
***Indicates sample weight below 0.05 grams and is considered insufficient for quantitative analysis.*

ANALYST: Stacy Ulrich

APPROVED BY: Tianbao Bai, Ph.D., CIH
Laboratory Director

Phoenix EnviroCorp
4020 SHIPYARD BLVD.
WILMINGTON, NC 28403

CHAIN OF CUSTODY

LABORATORY TEST REQUEST

CONTACT: Tommie Green	PHONE: (910) 397-0370 FAX: (910) 313-6094 EMAIL: kmgreen@phoenixenvirocorp.com	DATE SAMPLED:	7/7/2023
PEC Job #: 21-23-081A-AB-I	CLIENT'S JOB NAME: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526		

SAMPLE TYPE:	NUMBER OF SAMPLES:	TURN AROUND TIME SPECIFIED:
Asbestos Bulk (PLM)	15	____ 2 Hr __X__ 6 Hr ____ 24 Hr ____ 48 Hr ____ 3-5 Day
TEM	5	

SPECIAL INSTRUCTIONS: 1.) Stop at first positive for each homogeneous area (HGA). 2.) List positive stops on analysis form. 3.) Separate all layers prior to analysis. 4.) Do not analyze ceramic tile; analyze any associated mastic, grout, mortar, backerboard, etc. . 5.) Do not analyze fiberglass. 6.) Confirm negative results for non-friable, organically bound material with one (1) TEM analysis per HGA. 7.) Any drywall or joint compound HGA that is > 1%, but < 5% shall be re-analyzed (separately) utilizing EPA 400 point count method. 8.) Please email results.

Sample #	Sample Area	Sample Date	HGA	Sq. Footage	Lab Analysis Requested
070723-TG-01	Off white HVA duct insulation located on the roof	07/07/23	14	120 LF	PLM
070723-TG-02	Off white HVA duct insulation located on the roof	07/07/23	14	120 LF	PLM
070723-TG-03	Off white HVA duct insulation located on the roof	07/07/23	14	120 LF	PLM
070723-TG-04	Black HVAC duct insulation located on the roof	07/07/23	15	54	PLM
070723-TG-05	Black HVAC duct insulation located on the roof	07/07/23	15	54	PLM
070723-TG-06	Black HVAC duct insulation located on the roof	07/07/23	15	54	PLM
070723-TG-07	Roof flashing	07/07/23	16	432 LF	PLM
070723-TG-08	Roof flashing	07/07/23	16	432 LF	PLM
070723-TG-09	Roof flashing	07/07/23	16	432 LF	PLM
070723-TG-10	Shingle roof system	07/07/23	17	1,520	PLM
070723-TG-11	Shingle roof system	07/07/23	17	1,520	PLM
070723-TG-12	Shingle roof system	07/07/23	17	1,520	PLM
070723-TG-13	Flat roof system	07/07/23	18	3,960	PLM
070723-TG-14	Flat roof system	07/07/23	18	3,960	PLM
070723-TG-15	Flat roof system	07/07/23	18	3,960	PLM

CHAIN OF CUSTODY RECORD

DATE	CONDITION OF SAMPLE	SAMPLES RECEIVED BY	SAMPLES RELEASED BY
7/7/2023	SEALED/GOOD	SIGNATURE	SIGNATURE 

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July 10, 2023

Phoenix EnviroCorp
4020 Shipyard Boulevard
Wilmington, NC 28403

CLIENT PROJECT: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23 -081A-AB-I
CEI LAB CODE: B2314469

Dear Customer:

Enclosed are asbestos analysis results for PLM Bulk samples received at our laboratory on July 10, 2023. The samples were analyzed for asbestos using polarizing light microscopy (PLM) per the EPA 600 Method.

Sample results containing >1% asbestos are considered asbestos-containing materials (ACMs) per EPA regulatory requirements. The detection limit for the EPA 600 Method is <1% asbestos by weight as determined by visual estimation.

Thank you for your business and we look forward to continuing good relations.

Kind Regards,

Tianbao Bai, Ph.D., CIH
Laboratory Director

NVLAP® TESTING
NVLAP LAB CODE 101768-0

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ASBESTOS ANALYTICAL REPORT
By: Polarized Light Microscopy

Prepared for

Phoenix EnviroCorp

CLIENT PROJECT:	Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081A-AB-I
LAB CODE:	B2314469
TEST METHOD:	EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020
REPORT DATE:	07/10/23
TOTAL SAMPLES ANALYZED:	12
# SAMPLES >1% ASBESTOS:	1

730 SE Maynard Road • Cary, NC 27511 • 919.481.1413

Asbestos Report Summary

By: POLARIZING LIGHT MICROSCOPY

PROJECT: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081A-AB-I

LAB CODE: B2314469

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

Client ID	Layer	Lab ID	Color	Sample Description	ASBESTOS %
070723-TG-01	Layer 1	B2314469.01	Off-white,Black	Coating Material	None Detected
	Layer 2	B2314469.01	Silver,Black	Silver Paint	None Detected
	Layer 3	B2314469.01	Silver,Yellow	Wrap	None Detected
070723-TG-02	Layer 1	B2314469.02	Off-white,Black	Coating Material	None Detected
	Layer 2	B2314469.02	Silver,Black	Silver Paint	None Detected
	Layer 3	B2314469.02	Silver,Yellow	Wrap	None Detected
070723-TG-03	Layer 1	B2314469.03		Sample Submitted for TEM Analysis	
	Layer 2	B2314469.03		Sample Submitted for TEM Analysis	
	Layer 3	B2314469.03	Silver,Yellow	Wrap	None Detected
070723-TG-04	Layer 1	B2314469.04	Black	Tar	None Detected
	Layer 2	B2314469.04	Black	Non-fibrous Material	None Detected
	Layer 3	B2314469.04	Silver,Black	Silver Paint	None Detected
070723-TG-05	Layer 1	B2314469.05	Black	Tar	None Detected
	Layer 2	B2314469.05	Black	Non-fibrous Material	None Detected
	Layer 3	B2314469.05	Silver,Black	Silver Paint	None Detected
070723-TG-06	Layer 1	B2314469.06		Sample Submitted for TEM Analysis	
	Layer 2	B2314469.06		Sample Submitted for TEM Analysis	
	Layer 3	B2314469.06		Sample Submitted for TEM Analysis	
070723-TG-07		B2314469.07	White,Gray	Roof Flashing	None Detected
070723-TG-08		B2314469.08	White,Gray	Roof Flashing	None Detected
070723-TG-09		B2314469.09		Sample Submitted for TEM Analysis	
070723-TG-10	Layer 1	B2314469.10A	Black	Shingle Roof	None Detected
	Layer 2	B2314469.10A	Green,Black	Shingle Roof	None Detected
	Layer 1	B2314469.10B	Brown,Black	Shingle Roof	None Detected
	Layer 2	B2314469.10B	Black	Tar	Chrysotile 2%
		B2314469.10C	Black	Felt Paper	None Detected
		B2314469.10D	Black	Felt Paper	None Detected

Asbestos Report Summary

By: POLARIZING LIGHT MICROSCOPY

PROJECT: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081A-AB-I

LAB CODE: B2314469

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

Client ID	Layer	Lab ID	Color	Sample Description	ASBESTOS %
070723-TG-11	Layer 1	B2314469.11A	Black	Shingle Roof	None Detected
	Layer 2	B2314469.11A	Green,Black	Shingle Roof	None Detected
	Layer 1	B2314469.11B	Brown,Black	Shingle Roof	None Detected
	Layer 2	B2314469.11B		Sample Not Analyzed per COC	
		B2314469.11C	Black	Felt Paper	None Detected
		B2314469.11D	Black	Felt Paper	None Detected
070723-TG-12	Layer 1	B2314469.12A		Sample Submitted for TEM Analysis	
	Layer 2	B2314469.12A		Sample Submitted for TEM Analysis	
	Layer 1	B2314469.12B		Sample Submitted for TEM Analysis	
	Layer 2	B2314469.12B		Sample Not Analyzed per COC	
		B2314469.12C		Sample Submitted for TEM Analysis	
		B2314469.12D		Sample Submitted for TEM Analysis	
070723-TG-13	Layer 1	B2314469.13	Cream	Roof Foam	None Detected
	Layer 2	B2314469.13	Brown	Roof Paper	None Detected
070723-TG-14	Layer 1	B2314469.14	Cream	Roof Foam	None Detected
	Layer 2	B2314469.14	Brown	Roof Paper	None Detected
	Layer 3	B2314469.14	Black	Tar	None Detected
	Layer 4	B2314469.14	Tan	Membrane	None Detected
070723-TG-15	Layer 1	B2314469.15	Cream	Roof Foam	None Detected
	Layer 2	B2314469.15	Brown	Roof Paper	None Detected
	Layer 3	B2314469.15		Sample Submitted for TEM Analysis	
	Layer 4	B2314469.15		Sample Submitted for TEM Analysis	

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Phoenix EnviroCorp
4020 Shipyard Boulevard
Wilmington, NC 28403

Lab Code: B2314469
Date Received: 07-10-23
Date Analyzed: 07-10-23
Date Reported: 07-10-23

Project: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081A-AB-I

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
070723-TG -01	Coating Material	Homogeneous			100%	Binder	None Detected
Layer 1		Off-white,Black					
B2314469.01		Non-fibrous					
		Bound					
No duct insulation present. Sample appears to be coating material, silver paint and wrap.							
Layer 2	Silver Paint	Heterogeneous	<1%	Cellulose	80%	Paint	None Detected
B2314469.01		Silver,Black			20%	Tar	
		Non-fibrous					
		Bound					
Layer 3	Wrap	Heterogeneous	45%	Cellulose	50%	Metal Foil	None Detected
B2314469.01		Silver,Yellow	5%	Fiberglass			
		Non-fibrous					
		Loosely Bound					
070723-TG -02	Coating Material	Homogeneous			100%	Binder	None Detected
Layer 1		Off-white,Black					
B2314469.02		Non-fibrous					
		Bound					
No duct insulation present. Sample appears to be coating material, silver paint and wrap.							
Layer 2	Silver Paint	Heterogeneous	<1%	Cellulose	80%	Paint	None Detected
B2314469.02		Silver,Black			20%	Tar	
		Non-fibrous					
		Bound					
Layer 3	Wrap	Heterogeneous	45%	Cellulose	50%	Metal Foil	None Detected
B2314469.02		Silver,Yellow	5%	Fiberglass			
		Non-fibrous					
		Loosely Bound					
070723-TG -03	Sample Submitted for TEM Analysis						
Layer 1							
B2314469.03							
Sample appears to be NOB. Sample sent for TEM analysis.							

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Phoenix EnviroCorp
4020 Shipyard Boulevard
Wilmington, NC 28403

Lab Code: B2314469
Date Received: 07-10-23
Date Analyzed: 07-10-23
Date Reported: 07-10-23

Project: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081A-AB-I

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
Layer 2 B2314469.03	Sample Submitted for TEM Analysis						
Sample appears to be NOB. Sample sent for TEM analysis.							
Layer 3 B2314469.03	Wrap	Heterogeneous Silver,Yellow Non-fibrous Loosely Bound	45% 5%	Cellulose Fiberglass	50%	Metal Foil	None Detected
070723-TG -04 Layer 1 B2314469.04	Tar	Heterogeneous Black Non-fibrous Bound			100%	Tar	None Detected
Sample appears to be tar and non-fibrous material. No duct insulation present.							
Layer 2 B2314469.04	Non-fibrous Material	Homogeneous Black Non-fibrous Bound			100%	Binder	None Detected
Layer 3 B2314469.04	Silver Paint	Heterogeneous Silver,Black Non-fibrous Bound	<1%	Cellulose	80% 20%	Paint Tar	None Detected
070723-TG -05 Layer 1 B2314469.05	Tar	Heterogeneous Black Non-fibrous Bound			100%	Tar	None Detected
Sample appears to be tar and non-fibrous material. No duct insulation present.							
Layer 2 B2314469.05	Non-fibrous Material	Homogeneous Black Non-fibrous Bound			100%	Binder	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Phoenix EnviroCorp
4020 Shipyard Boulevard
Wilmington, NC 28403

Lab Code: B2314469
Date Received: 07-10-23
Date Analyzed: 07-10-23
Date Reported: 07-10-23

Project: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081A-AB-I

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
Layer 3 B2314469.05	Silver Paint	Heterogeneous Silver,Black Non-fibrous Bound	<1%	Cellulose	80% 20%	Paint Tar	None Detected
070723-TG -06 Layer 1 B2314469.06	Sample Submitted for TEM Analysis						
Sample appears to be NOB. Sample sent for TEM analysis.							
Layer 2 B2314469.06	Sample Submitted for TEM Analysis						
Sample appears to be NOB. Sample sent for TEM analysis.							
Layer 3 B2314469.06	Sample Submitted for TEM Analysis						
Sample appears to be NOB. Sample sent for TEM analysis.							
070723-TG -07 B2314469.07	Roof Flashing	Heterogeneous White,Gray Fibrous Bound	5%	Synthetic Fiber	95% <1% <1%	Rubber Mastic Tar	None Detected
070723-TG -08 B2314469.08	Roof Flashing	Heterogeneous White,Gray Fibrous Bound	5%	Synthetic Fiber	95% <1% <1%	Rubber Mastic Tar	None Detected
070723-TG -09 B2314469.09	Sample Submitted for TEM Analysis						
Sample appears to be NOB. Sample sent for TEM analysis.							
070723-TG -10 Layer 1 B2314469.10A	Shingle Roof	Heterogeneous Black Fibrous Bound	50%	Fiberglass	40% 10%	Tar Gravel	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Phoenix EnviroCorp
4020 Shipyard Boulevard
Wilmington, NC 28403

Lab Code: B2314469
Date Received: 07-10-23
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Project: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081A-AB-I

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
Layer 2 B2314469.10A	Shingle Roof	Heterogeneous Green,Black Fibrous Bound	50%	Fiberglass	40% 10%	Tar Gravel	None Detected
Layer 1 B2314469.10B	Shingle Roof	Heterogeneous Brown,Black Fibrous Bound	50%	Fiberglass	40% 10%	Tar Gravel	None Detected
Layer 2 B2314469.10B	Tar	Heterogeneous Black Non-fibrous Bound	5%	Cellulose	93%	Tar	2% Chrysotile
B2314469.10C	Felt Paper	Heterogeneous Black Fibrous Bound	70%	Cellulose	30%	Tar	None Detected
B2314469.10D	Felt Paper	Heterogeneous Black Fibrous Bound	70%	Fiberglass	30%	Tar	None Detected
070723-TG -11 Layer 1 B2314469.11A	Shingle Roof	Heterogeneous Black Fibrous Bound	50%	Fiberglass	40% 10%	Tar Gravel	None Detected
Layer 2 B2314469.11A	Shingle Roof	Heterogeneous Green,Black Fibrous Bound	50%	Fiberglass	40% 10%	Tar Gravel	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Phoenix EnviroCorp
4020 Shipyard Boulevard
Wilmington, NC 28403

Lab Code: B2314469
Date Received: 07-10-23
Date Analyzed: 07-10-23
Date Reported: 07-10-23

Project: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081A-AB-I

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
Layer 1 B2314469.11B	Shingle Roof	Heterogeneous Brown,Black Fibrous Bound	50%	Fiberglass	40% 10%	Tar Gravel	None Detected
Layer 2 B2314469.11B	Sample Not Analyzed per COC						
B2314469.11C	Felt Paper	Heterogeneous Black Fibrous Bound	70%	Cellulose	30%	Tar	None Detected
B2314469.11D	Felt Paper	Heterogeneous Black Fibrous Bound	70%	Fiberglass	30%	Tar	None Detected
070723-TG -12 Layer 1 B2314469.12A	Sample Submitted for TEM Analysis						
Sample appears to be NOB. Sample sent for TEM analysis.							
Layer 2 B2314469.12A	Sample Submitted for TEM Analysis						
Sample appears to be NOB. Sample sent for TEM analysis.							
Layer 1 B2314469.12B	Sample Submitted for TEM Analysis						
Sample appears to be NOB. Sample sent for TEM analysis.							
Layer 2 B2314469.12B	Sample Not Analyzed per COC						
B2314469.12C	Sample Submitted for TEM Analysis						
Sample appears to be NOB. Sample sent for TEM analysis.							

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Phoenix EnviroCorp
4020 Shipyard Boulevard
Wilmington, NC 28403

Lab Code: B2314469
Date Received: 07-10-23
Date Analyzed: 07-10-23
Date Reported: 07-10-23

Project: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081A-AB-I

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
B2314469.12D	Sample Submitted for TEM Analysis						
Sample appears to be NOB. Sample sent for TEM analysis.							
070723-TG -13 Layer 1 B2314469.13	Roof Foam	Homogeneous Cream Non-fibrous Bound			100%	Foam	None Detected
Layer 2 B2314469.13	Roof Paper	Homogeneous Brown Fibrous Bound	95% 5%	Cellulose Fiberglass			None Detected
070723-TG -14 Layer 1 B2314469.14	Roof Foam	Homogeneous Cream Non-fibrous Bound			100%	Foam	None Detected
Layer 2 B2314469.14	Roof Paper	Homogeneous Brown Fibrous Bound	95% 5%	Cellulose Fiberglass			None Detected
Layer 3 B2314469.14	Tar	Heterogeneous Black Non-fibrous Bound			100%	Tar	None Detected
Layer 4 B2314469.14	Membrane	Homogeneous Tan Non-fibrous Bound	5%	Synthetic Fiber	95%	Rubber	None Detected
070723-TG -15 Layer 1 B2314469.15	Roof Foam	Homogeneous Cream Non-fibrous Bound			100%	Foam	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Phoenix EnviroCorp
4020 Shipyard Boulevard
Wilmington, NC 28403

Lab Code: B2314469
Date Received: 07-10-23
Date Analyzed: 07-10-23
Date Reported: 07-10-23

Project: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081A-AB-I

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous	Non-Fibrous	ASBESTOS %
Layer 2 B2314469.15	Roof Paper	Homogeneous Brown Fibrous Bound	95% 5%	Cellulose Fiberglass	None Detected
Layer 3 B2314469.15	Sample Submitted for TEM Analysis				
Sample appears to be NOB. Sample sent for TEM analysis.					
Layer 4 B2314469.15	Sample Submitted for TEM Analysis				
Sample appears to be NOB. Sample sent for TEM analysis.					

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LEGEND: Non-Anth = Non-Asbestiform Anthophyllite
Non-Trem = Non-Asbestiform Tremolite
Calc Carb = Calcium Carbonate

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

REPORTING LIMIT: <1% by visual estimation

REPORTING LIMIT FOR POINT COUNTS: 0.25% by 400 Points or 0.1% by 1,000 Points

REGULATORY LIMIT: >1% by weight

Due to the limitations of the EPA 600 method, nonfriable organically bound materials (NOBs) such as vinyl floor tiles can be difficult to analyze via polarized light microscopy (PLM). EPA recommends that all NOBs analyzed by PLM, and found not to contain asbestos, be further analyzed by Transmission Electron Microscopy (TEM). Please note that PLM analysis of dust and soil samples for asbestos is not covered under NVLAP accreditation. *Estimated measurement of uncertainty is available on request.*

This report relates only to the samples tested or analyzed and may not be reproduced, except in full, without written approval by Eurofins CEI. Eurofins CEI makes no warranty representation regarding the accuracy of client submitted information in preparing and presenting analytical results. Interpretation of the analytical results is the sole responsibility of the client. Samples were received in acceptable condition unless otherwise noted. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. Government.

Information provided by customer includes customer sample ID and sample description.

ANALYST: Nicholas Moore

APPROVED BY: Tianbao Bai, Ph.D., CIH
Laboratory Director

NVLAP® TESTING
NVLAP LAB CODE 101768-0

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July 11, 2023

Phoenix EnviroCorp
4020 Shipyard Boulevard
Wilmington, NC 28403

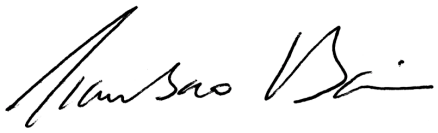
CLIENT PROJECT: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23 -081A-AB-I
LAB CODE: T231442

Dear Customer:

Enclosed are asbestos analysis results for TEM bulk samples received at our laboratory on July 10, 2023. The samples were analyzed for asbestos using transmission electron microscopy (TEM) per Chatfield/EPA 600/R-93/116 Sec. 2.5.5.1 method.

Sample results containing > 1% asbestos are considered asbestos-containing materials (ACMs) per the EPA regulatory requirements. The detection limit for the TEM Chatfield/EPA 600/R-93/116 Sec. 2.5.5.1 method is <1% depending on the processed weight and constituents of the sample.

Kind Regards,



Tianbao Bai, Ph.D., CIH
Laboratory Director

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ASBESTOS ANALYTICAL REPORT
By: Transmission Electron Microscopy

Prepared for

Phoenix EnviroCorp

CLIENT PROJECT:	Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081A-AB-I
LAB CODE:	T231442
TEST METHOD:	Bulk Chatfield EPA 600 / R93 / 116 Sec. 2.5.5.1
REPORT DATE:	07/11/23

730 SE Maynard Road • Cary, NC 27511 • 919.481.1413

ASBESTOS BULK ANALYSIS

By: TRANSMISSION ELECTRON MICROSCOPY

Client: Phoenix EnviroCorp
4020 Shipyard Boulevard
Wilmington, NC 28403

Lab Code: T231442
Date Received: 07-10-23
Date Analyzed: 07-11-23
Date Reported: 07-11-23

Project: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081A-AB-I

TEM BULK CHATFIELD / EPA 600 / R93 / 116 Sec. 2.5.5.1

Client ID Lab ID	Material Description	Sample Weight (g)	Organic Material %	Acid Soluble Material %	Acid Insoluble Material %	Asbestos %
070723-TG-03 T62053	Off-White, Black Coating Material	0.1004	40.1	48.9	11	**None Detected**
070723-TG-03 T62054	Silver, Black Silver Paint	0.0778	56	9.3	34.7	**None Detected**
070723-TG-06 T62055	Black Tar	0.166	70.7	18.4	10.9	**None Detected**
070723-TG-06 T62056	Black Non-fibrous Material	0.2637	66.4	8.9	24.7	**None Detected**
070723-TG-06 T62057	Silver, Black Silver Paint	0.0979	64.2	15.3	20.5	**None Detected**
070723-TG-09 T62058	White, Gray Roof Flashing	0.2754	91.5	2.7	5.8	**None Detected**
070723-TG-12 T62059	Black Shingle Roof	0.2733	20.9	44.4	34.7	**None Detected**
070723-TG-12 T62060	Green, Black Shingle Roof	0.3257	24.2	33.1	42.7	**None Detected**
070723-TG-12 T62061	Brown, Black Shingle Roof	0.2903	27.6	39.7	32.7	**None Detected**

ASBESTOS BULK ANALYSIS

By: TRANSMISSION ELECTRON MICROSCOPY

Client: Phoenix EnviroCorp
4020 Shipyard Boulevard
Wilmington, NC 28403

Lab Code: T231442
Date Received: 07-10-23
Date Analyzed: 07-11-23
Date Reported: 07-11-23

Project: Hackler Clubhouse, 107 Citadel Drive, Conway, SC 29526, 21-23-081A-AB-I

TEM BULK CHATFIELD / EPA 600 / R93 / 116 Sec. 2.5.5.1

Client ID Lab ID	Material Description	Sample Weight (g)	Organic Material %	Acid Soluble Material %	Acid Insoluble Material %	Asbestos %
070723-TG -12 T62062	Black Felt Paper	0.4729	71.4	15.1	13.5	**<1% Chrysotile**
Possible contamination from positive layer in sample bag.						
070723-TG -12 T62063	Black Felt Paper	0.2912	83	3.9	13.1	**None Detected**
070723-TG -15 T62064	Black Tar	0.1173	95.4	2.9	1.7	**None Detected**
070723-TG -15 T62065	Tan Membrane	0.1135	60.1	36.4	3.5	**None Detected**

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LEGEND: None

METHOD: CHATFIELD & EPA/600/R-93/116 Sec. 2.5.5.1

LIMIT OF DETECTION: Varies with the weight and constituents of the sample (<1%)

REGULATORY LIMIT: >1% by weight

This report relates only to the samples tested or analyzed and may not be reproduced, except in full, without written approval by Eurofins CEI (ECEI). ECEI makes no warranty representation regarding the accuracy of client submitted information in preparing and presenting analytical results. Interpretation of the analytical results is the sole responsibility of the client. *Estimated measurement of uncertainty is available on request and in compliance with regulatory requirements.* Samples were received in acceptable condition unless otherwise noted.

Information provided by customer includes customer sample ID, location, volume and area as well as date and time of sampling.
ECEI recommends between 0.20 and 0.50 grams of sample material for TEM bulk analysis.
Any weight below 0.10 grams is considered below protocol guidelines.
***Indicates sample weight below 0.05 grams and is considered insufficient for quantitative analysis.*

ANALYST: Stacy Ulrich

APPROVED BY: Tianbao Bai, Ph.D., CIH
Laboratory Director

United States Department of Commerce
National Institute of Standards and Technology

Certificate of Accreditation to ISO/IEC 17025:2017

NVLAP LAB CODE: 101768-0

Eurofins CEI, Inc.

Cary, NC

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

Asbestos Fiber Analysis

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2023-04-01 through 2024-03-31

Effective Dates

DEPARTMENT OF COMMERCE * UNITED STATES OF AMERICA *

For the National Voluntary Laboratory Accreditation Program

National Voluntary Laboratory Accreditation Program

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

Eurofins CEI, Inc.
730 SE Maynard Road
Cary, NC 27511
Dr. Tianbao Bai
Phone: 919-481-1413 Fax: 919-481-1442
Email: tianbao.bai@eurofinset.com
http://www.eurofinsus.com/CEI

ASBESTOS FIBER ANALYSIS — NVLAP LAB CODE 101768-0

Bulk Asbestos Analysis

Code	*Description*
18/A01	EPA -- 40 CFR Appendix E to Subpart E of Part 763, Interim Method of the Determination of Asbestos in Bulk Insulation Samples
18/A03	EPA 600/R-93/116: Method for the Determination of Asbestos in Bulk Building Materials

Airborne Asbestos Analysis

Code	*Description*
18/A02	U.S. EPA's "Interim Transmission Electron Microscopy Analytical Methods-Mandatory and Nonmandatory-and Mandatory Section to Determine Completion of Response Actions" as found in 40 CFR, Part 763, Subpart E, Appendix A.

For the National Voluntary Laboratory Accreditation Program

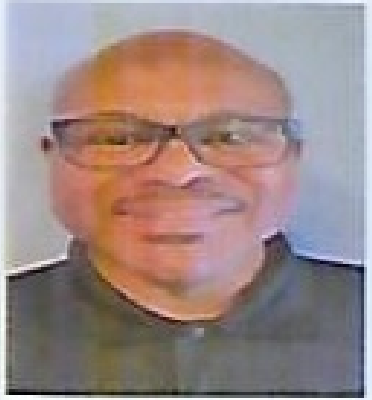
Phoenix EnviroCorp

Appendix B – Asbestos Inspector License

SCDHEC ISSUED

Asbestos ID Card

Tommie Green

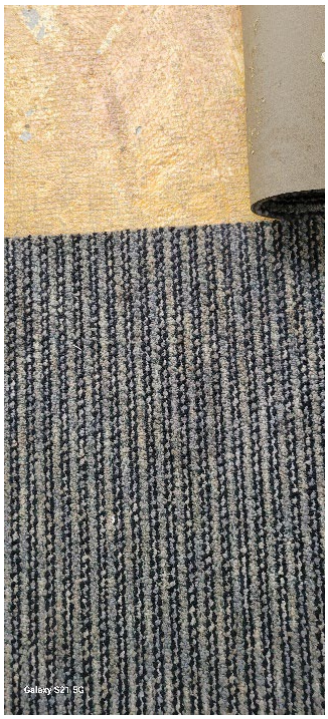


		Expiration Date:
CONSULTMP	MP-00184	03/01/24
CONSULTPD	PD-00123	03/02/24

Phoenix EnviroCorp

Appendix C – Photographic documentation

Photo 1



Mastic associated with multicolored carpet

Photo 2



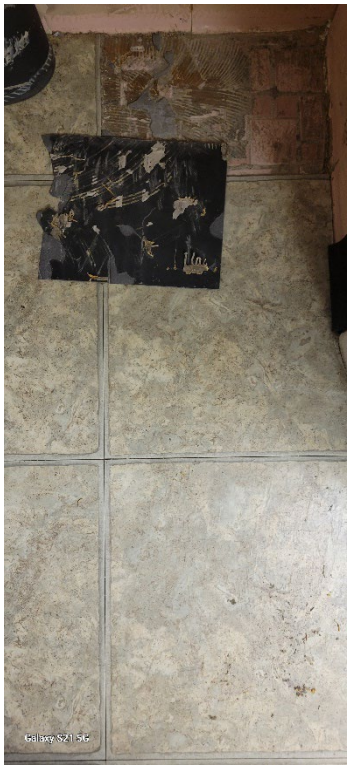
Mastic associated with black base cove

Photo 3



Leveling compound associated with green carpet

Photo 4



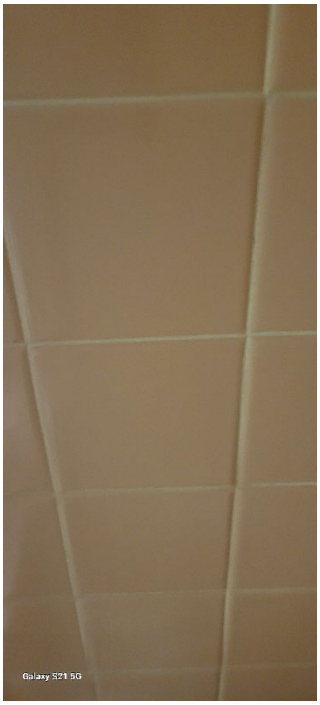
Vinyl flooring/associated mastic located in the women's restroom

Photo 5



Pink ceramic floor system located in the women's restroom

Photo 6



Pink ceramic wall system located in the women's restroom

Photo 7



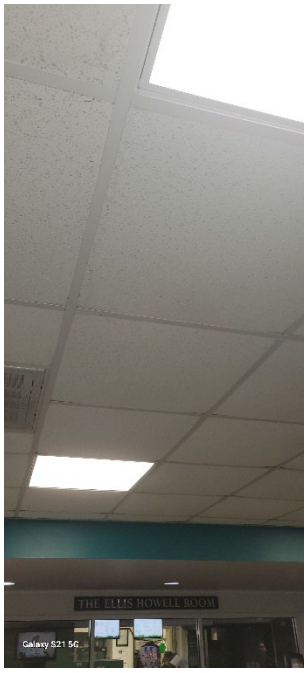
Multilayer ceramic tile floor system located in the men's restroom

Photo 8



Vinyl wallpaper (two layers) located in the hallway to the women's bathroom

Photo 9

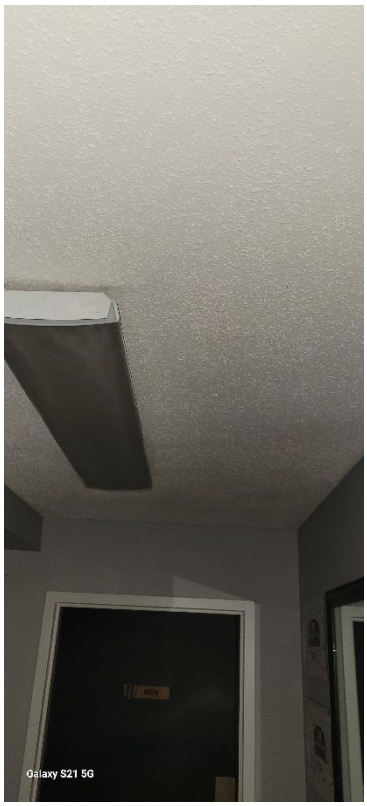


Ceiling panels located in the dining room

Photo 10



Wavey ceiling texture located in the various locations throughout the building



Popcorn ceiling texture located in various locations throughout the building

Photo 1



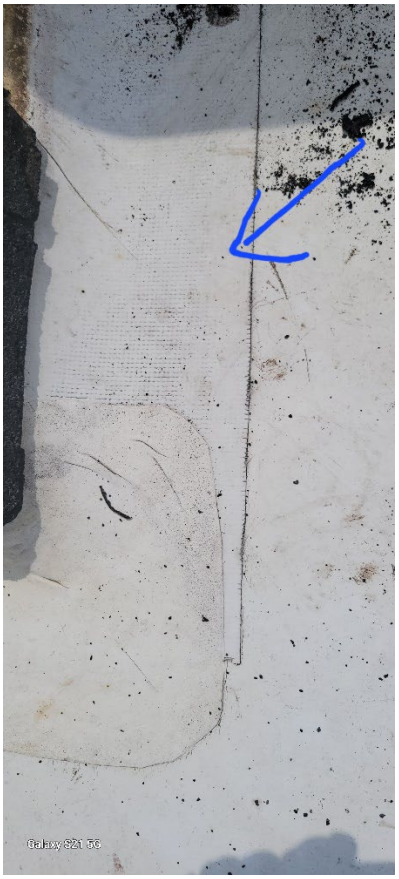
Black HVAC duct insulation located on the roof

Photo 2



Off white HVAC duct insulation location on the roof

Photo 3



Roof flashing

Photo 4



Flat roof system